Exhibit 10 (a)

8.0. Opinion 4 – Area-wide Activities Elevated the Metals Load in Carteret

The historical record supports that there were widespread agricultural activities within the proposed class area, which would have included pesticides, fungicides, and fertilizers containing arsenic, copper, and/or lead from the mid-19th century through the early 1930s. Agricultural activities created an elevated baseline of metals within the proposed class area and may have also contributed to localized site-specific impacts. In addition to agricultural activities, the widespread use of leaded gasoline through the 1980s resulted in elevated levels of lead in soil throughout the proposed class area.

8.1 Historical Agricultural Activities

Before becoming industrialized, much of the land in and around Carteret was used for agriculture. An 1850 map of the portion of Woodbridge Township that later became Carteret identifies several landowners spread across the Carteret area, with unpopulated areas consisting of forested land or marshland (Figure 7-24). The 1850 Census identified at least seven farmers in the Carteret area, all of which grew Irish potatoes and all but one had orchard produce.[142] The 1870 census identified 11 farmers in the Carteret area, all of which grew Irish potatoes and six of which also had fruit orchards.[143] Similar farming patterns were also identified in the 1880 census.[144] While farming in the eastern portion of the proposed class area had largely ceased by the early 1900s, an analysis of aerial photography from 1931, 1940, and 1947 indicates that farming continued in the western and northwestern portions of the proposed class area into the early 1930s.[145]

By the 1870s, potato farming and orchard produce are significant for their use of arsenic and copper containing pesticides. Copper arsenate, also known as Paris Green, is a complex compound of copper metarsenite and copper acetate. Paris Green was widely used on potatoes and was probably the most commonly used insecticide between 1880 and 1900.[146] An 1876 newspaper advertisement for a local feed and seed store in Woodbridge (the nearest town at the time to Carteret) advertised Paris Green as a "potato-bug exterminator" (Figure 8-1).[147] Moreover, there are site-specific reports of severe infestations of the Colorado potato beetle (or "potato bug) in the Carteret area, which was typically controlled by farmers with Paris green, and newspaper reports of agricultural applications of Paris green causing poisonings in nearby Rahway.[148]

Figure 8-1. Paris Green advertisement from 1876

142 Gravel, 2018. Pg. 5/74.
143 Gravel, 2019. Pg. 13-14/77.
144 Gravel, 2019. Pg. 14-15/77.
145 Stout, 2019. Pg. 2-3/11.
146 Murphy and Aucott, 1998. Pg. 4/13.
147 Gravel, 2019. Pg. 19/77.
148 Gravel, 2019. Pg. 17/77.

The Bordeaux Mixture is a copper sulfate mixture that was also widely used in historical agricultural practices. In 1889, The New Jersey Board of Agriculture recommended use of the Bordeaux Mixture to treat potato blight.[149] By 1903, arsenic had been added to the Bordeaux Mixture to create a Bordeaux-Arsenic mixture which was described as "an almost perfect preventative of all the diseases and insects attacking the foliage of our potato plants in the later stages of their growth."[150] Aerial photography analysis confirms that potatoes were grown in the western and northwestern portions of the proposed class area through the early 1930s.[151]

Orchard crops also required the widespread use of agricultural chemicals. For example, in 1897, the New Jersey Agricultural Experiment Station published a bulletin advising farmers on "the present methods of practice in the growth and marketing of apples, as well as… the principles which underlie successful culture."[152] Coddling moth larvae, the common apple worm, "occurs all over the state and, where active measures are not taken, reduces the value of the crop more than one-half each year."[153] Spraying the orchard with Paris green or arsenate of lead was recommended to control coddling moth larvae.[154] "The spraying must be thoroughly done, since unless each of the apples to be protected is covered with a fine spray, the result will be more or less imperfect."[155]

All of these insecticides and fungicides contained significant quantities of metals, including arsenic, copper, and/or lead, and widespread applications of these agricultural chemicals are known to create an elevated baseline of metals in the soil of former agricultural lands. In 1940, researchers from Cornell University reported on the copper content of soils in Long Island, New York. The researchers noted that approximately 640 pounds of metallic copper per acre had been added in the form of Bordeaux mixture on land that had been used continuously for potato farming for 32 years. The researchers concluded that this application resulted in 180 pounds of metallic copper per acre in the farmed soil, indicating approximately one-third of the copper applied still remained in the soil.

A study published in 1981 by the Department of Chemistry of the Nova Scotia Agricultural College found "significantly higher" levels of arsenic in soils of orchards and potato fields where arsenic has been applied. This study found levels of total arsenic in orchard soil ranging up to 183.05 ppm.[156]

In 1998, two researchers from the NJDEP published a study on methods of estimating the amounts of lead and calcium arsenate pesticides used in New Jersey between 1900 and 1980. This study recognized that "the primary early agents recommended against crop pests in general in the US include Paris green (a copper-based arsenical);" and that "lead or calcium arsenate appears continuously in the NJAES and USDA recommendations."[157] Further, the study stated:

"Heavy metals like arsenic applied in the past may persist indefinitely in the environment. In fact, elevated levels of lead and arsenic have been found in former orchard soils in New Jersey."[158]

The NJDEP Historic Pesticide Contamination Task Force issued a report in March 1999 that found "the historical use of agricultural pesticides in New Jersey has resulted in pesticide residues of certain persistent pesticides in soil at concentrations that exceed the Department's residential soil cleanup criteria and may pose a human health risk."[159] The report also notes "there are also human factors that affect the occurrence and distribution of pesticide residues. During active farming activities certain pesticides were applied year after year based on specific crop recommendations. When land use changes… the excavation and transportation of top soil to other sites affect the distribution of the pesticides of

[149] Gravel, 2019. Pg. 23/77.
[150] Gravel, 2019. Pg. 25/77.
[151] Stout, 2019. Pg. 2-3/11.
[152] Gravel, 2019. Pg. 21/77.
[153] Gravel, 2019. Pg. 21/77.
[154] Gravel, 2019. Pg. 21/77.
[155] Gravel, 2019. Pg. 21/77.
[156] Gravel, 2019. Pg. 26/77.
[157] Gravel, 2019. Pg. 26/77.
[158] Gravel, 2019. Pg. 26-27/77.
[159] Gravel, 2019. Pg. 27/77.

concern… Typical site development activities, such as the excavation of basements, the installation of water and sewer lines, and streets, generally result in the mixing of contaminated soil with underlying clean soil which is likely to reduce pesticide concentration levels at the surface."[160]

Moreover, the SEM analyses completed by Mr. Mattingly on soil samples provides additional supporting evidence for the historical use of agricultural chemicals within the proposed class area impacting arsenic soil concentrations. Arsenic was observed in soil samples bound to iron (Fe) within microscopic cracks inside of soil particles (Figure 8-2). Photographs G and H in Figure 8-2 illustrate the location of the iron/arsenic compounds within small microscopic cracks. The transport mechanism that best explains the movement of arsenic into these microscopic cracks is transport of the arsenic via water infiltration through the soil column. Historical pesticide applications would be amenable to this kind of movement, but glassy thermogenic particles containing arsenic would not.[161] Mr. Mattingly confirmed this transport mechanism for water-borne arsenic via a laboratory simulation.[162]

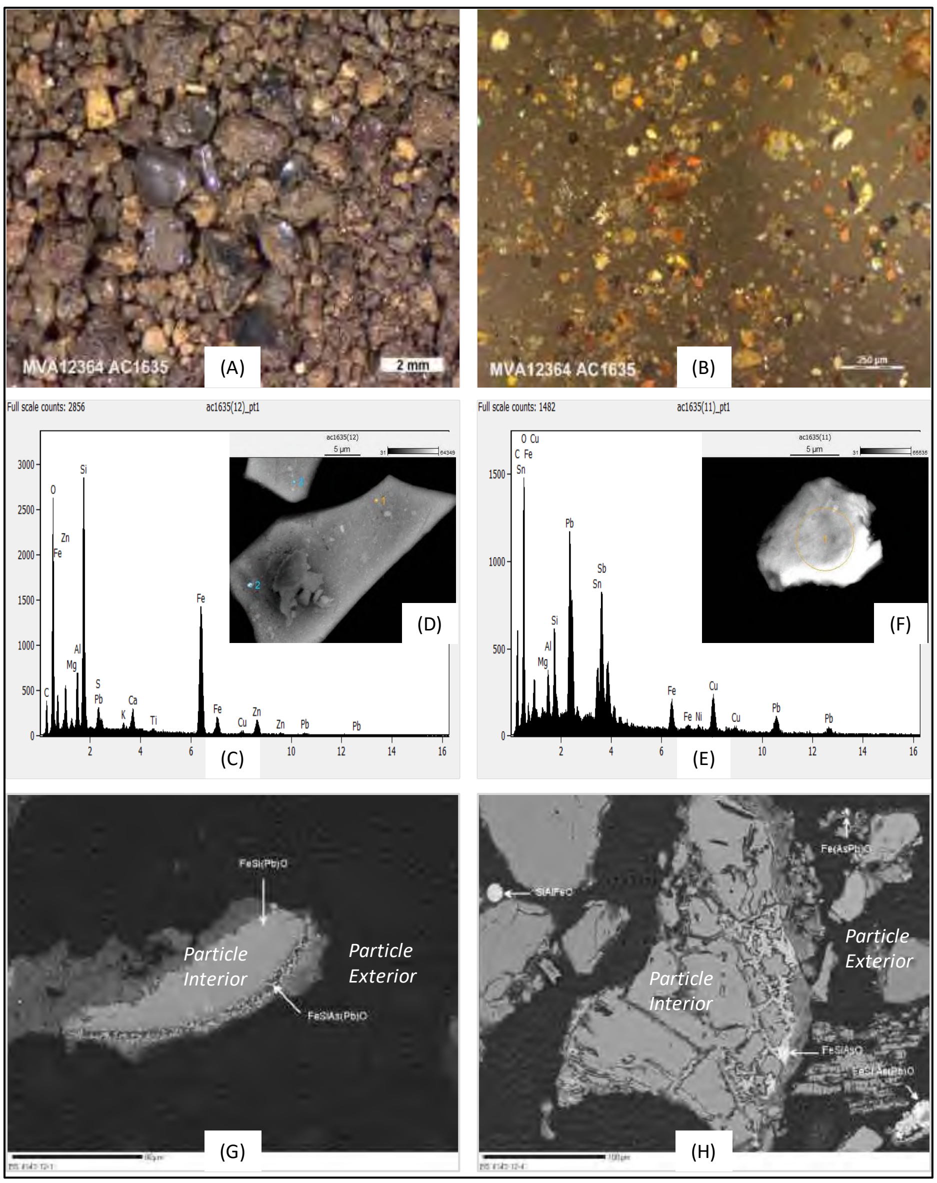

Figure 8-2. Arsenic observed within microscopic cracks of soil particles (Figure 17 from Mattingly report).

[160] Gravel, 2019. Pg. 27/77.
[161] Mattingly, 2019. Pg. 39/64.
[162] Mattingly, 2019. Pg. 31/64.

Based on the above, it is my opinion that agricultural activities created an elevated baseline of metals within much of the proposed class area and also likely caused localized site-specific impacts of elevated concentrations of arsenic, copper, and lead.

8.2 Leaded Gasoline

8.2.1 Overview

Lead can be found along roadways due to historical use of tetraethyl lead in gasoline. Leaded gasoline was introduced in the 1920s and by the 1940s the quantity of lead incorporated in gasoline exceeded that of lead in paint. Leaded gasoline use continued to increase until 1979 and then rapidly declined until banned in 1986.

The evidence from studies demonstrates that when particles from the combustion of leaded gasoline are released into the air, heavier particles are deposited near the street or point of use and the lighter particles are transported via air currents until they impact a barrier such as the exterior wall of a building. The lead particles on the surface of these barriers are washed into the surrounding soil during subsequent rainfall events. These findings are consistent with data showing high concentrations of lead in yards of brick constructed homes or from houses which have never been painted with LBP. It has been postulated that residual lead from past auto exhaust deposition may pose a threat as significant as that posed by leaded paint.[163]

The concentrations of lead in topsoil near roadways is typically 30 to 2,000 ppm; these levels drop exponentially at about 25 meters from the roadway. Urban areas generally have higher lead levels (median levels in New Orleans is >840 ppm; in Minneapolis, it is 265). Smaller towns also have elevated lead levels near roadways, but to a much lesser degree.[164]

8.2.2 Forensic Analysis

The forensic chemistry analysis conducted by Mr. Mattingly also supports the impacts of leaded gasoline throughout the proposed class area. The characteristic particle size and morphology of leaded gasoline combustion emissions is illustrated in Figure 8 of Mattingly's report.[165] Mattingly found lead particles that match these characteristics in the soil samples from the proposed class area and concluded that his observations of "Pb specks are consistent with emissions from automobiles burning leaded gasoline."[166]

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[163] Sheets 2001, Mielke et al., 1997, Mielke and Reagan 1998, Mielke et al., 1999, Brown et al., 2008
[164] Sheets 2001, Mielke et al., 1997, Mielke and Reagan 1998, Mielke et al., 1999, Brown et al., 2008
[165] Mattingly, 2019. Pg. 30/64.

[166] Mattingly, 2019. Pg. 60/64.

9.0. Opinion 5 – Property-specific Characterization of Metal Sources

Detailed analysis of properties on a property-by-property basis demonstrates that the combination of sources at a given property are unique and definable.

9.1 Property Case Studies

Using the analytical tools and methods previously discussed including trend/pattern analysis, review of historical aerials and Sanborn maps, inspections of housing characteristics, and forensic microscopy, the unique combinations of sources at a given property can be identified if properties are analyzed on a property-by-property basis. Case studies of four properties are provided below to support this opinion. The four case study properties and the Duarte property (see Section 9.2) are shown on Figure 9-1.

Figure 9-1. Case Study Properties

9.1.1 - PPIN 7337 – 180 Pershing Ave

The property at PPIN 7337, 180 Pershing Avenue, is a two-story, 1,332 square foot house built in 1908. This property has a high number of samples with elevated arsenic and lead concentrations and is one of only two transect properties with a copper concentration exceeding the NJ SRS level. Soil data from PPIN 7337 is summarized below in Table 9-1. Due to the very small size of the front yard, samples were only collected from the back yard of the property.

Table 9-1. Summary of Samples from PPIN 7337

	Arsenic	Copper	Lead
Minimum (ppm)	7.2	20.4	37
Average (ppm)	130.2	863.7	1119.8
Maximum (ppm)	512	6550	3470
Samples > NJ SRS	16	1	17

Based on observations from the street-level inspection of the property, the current exterior type appears to be 100% siding. During the property inspection, a large shed was observed in the back yard and peeling paint was visible around the window trim of the house. Fill/non-native materials were observed in 16 samples collected from the property. The fill materials noted in the boring logs include gravel, coal, and cinder.

A review of historical Sanborn maps shows several features in the vicinity of the property that are no longer present. The 1912 Sanborn map shows a shed present in the backyard of the property, in the same footprint as the existing shed. The 1912 map also shows the Roosevelt News print shop is directly adjacent to the property to the south. The print shop also has a detached shed along the property line with PPIN 7337 (Figure 9-2). The lone copper exceedance was collected along the southern property line, adjacent to the former print shop shed. Printing plates and the inks/pigments used in the printing process both contained copper.[167]

[167] Tucker, et al. 1999. Pg. 1/20.

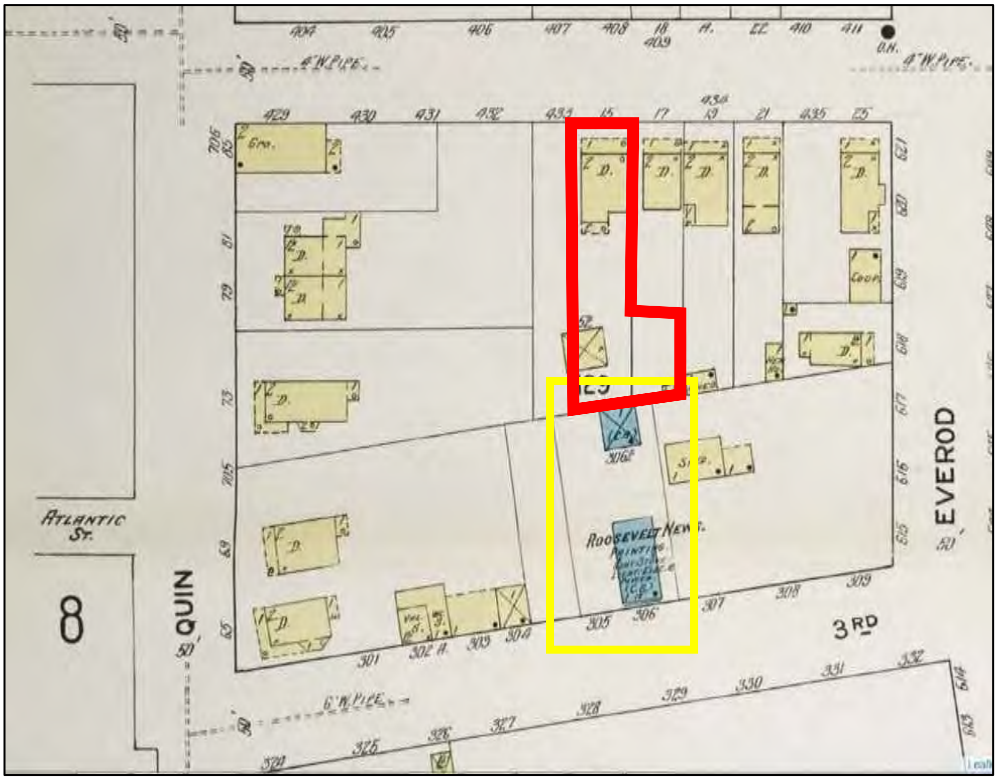

Figure 9-2 – 1912 Sanborn Map of PPIN 7337

The 1969 Sanborn map for the property still shows the print shop present on the adjacent property, although the shop has expanded from what was shown in the 1912 map. The 1969 Sanborn also shows an auto body repair shop located on the southeastern corner of the block, near the PPIN 7337 property. Brake pads are one of the most common sources of anthropogenic copper in the U.S.[168] Lastly, the 1969 Sanborn shows the shed present in the back yard of the property in the 1912 map is no longer present and another structure related to an adjacent property is present (Figure 9-3).

[168] In 2015, the USEPA and automotive industry signed an agreement to reduce copper in brake pads to less than 5% by weight by 2021 and 0.5% by 2025 (https://www.epa.gov/npdes/copper-free-brake-initiative).

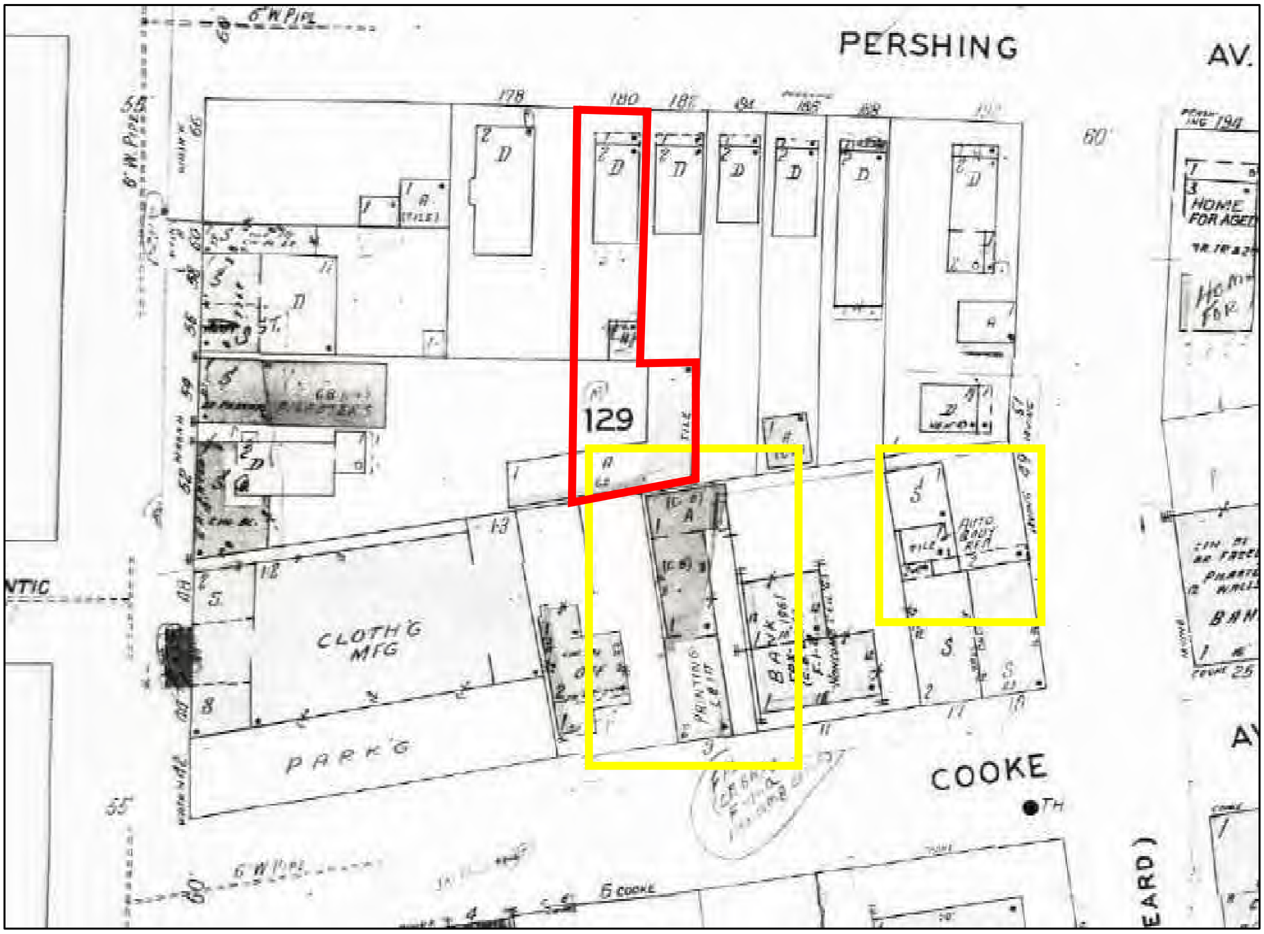

Figure 9-3. 1969 Sanborn map of PPIN 7337

Fill and non-native materials were observed in 16 samples collected from PPIN 7337. Fill materials noted in the boring logs include gravel, coal, and cinder. Microscopic analysis of soil samples from PPIN 7337 shows soil minerals, green stained glass, black glassy slag particles, and coal-like materials. Small lead inclusions are present on the slag and small lead particles are adhered to the coal (Figure 9-4).[169]

[169] Mattingly, 2019. Pg. 51/64.

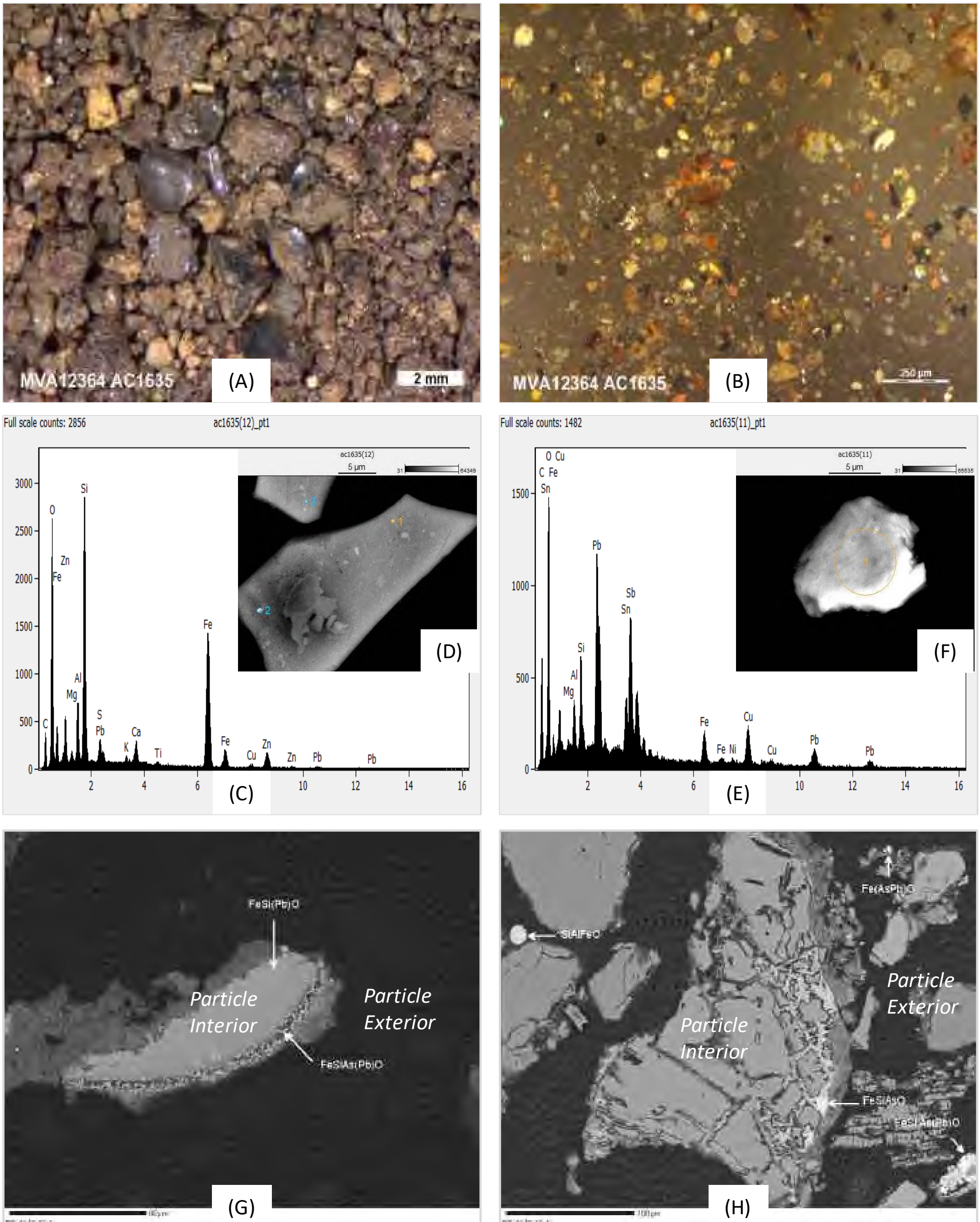

Figure 9-4: Northeast Transect Soil Sample 7337-B01-03-BG-G0020: (A) photo; (B) PLM photomicrograph; (C) stereo microscopy photomicrograph 7X; (D) stereo microscopy photomicrograph 20X; (E) slag type 1 EDS spectra and (F) SEM image; and (G) slag type 2 EDS spectra and (H) SEM image. (Figure 29 of Mattingly report)

These analyses show the metals concentrations present at PPIN 7337 are the result of a unique combination of impacts from lead-based paint, historical development and re-development patterns, adjacent commercial operations (print shop and auto shop), and the presence of fill materials. Source allocation for PPIN 7337 should be based on the evaluation of property specific evidence including: the horizontal and vertical spatial analysis of the soil sample results, metal ratio analysis of the soil samples, property construction and maintenance history, Sanborn maps of prior land use, evaluation of adjacent land historical use, boring log lithology, and microscopy the of soil samples. Each of these investigation topics is based primarily on physical and scientific evidence that is unique to this particular property.

9.1.2 - PPIN 7355 – 208 Pershing Avenue

The property at PPIN 7355, 208 Pershing Avenue, is a two-story, 1,424 square foot house built in 1900. This property has a high number of samples with elevated arsenic and lead concentrations and is one of the only two transect properties with a copper concentration exceeding the NJ SRS level. Soil data from PPIN 7355 is summarized below in Table 9-2. Due to the small size of the yards at PPIN 7355, samples were split between the side yard and back yard of the property.

Table 9-2. Summary of Samples from PPIN 7355

	Arsenic	Copper	Lead
Minimum (ppm)	15.1	90.6	341
Average (ppm)	28.5	419.6	1092.3
Maximum (ppm)	61.2	3180	2330
Samples > NJ SRS	14	1	18

Based on observations from the street-level inspection of the property, the current exterior type appears to be 100% painted brick. During the property inspection, a detached two-car garage was observed at the property and peeling paint was observed on the detached garage.

A review of historical Sanborn maps shows several features in the vicinity of the property that are no longer present. The 1931 Sanborn map for PPIN 7355 shows a large garage/auto body shop directly adjacent to the property to the south (Figure 9-5). A 1966 aerial photo shows the garage/auto repair shop with at least a dozen cars parked on the exterior of the property (Figure 9-6). The 1969 Sanborn still shows the garage/auto repair shop which appears to have expanded slightly (Figure 9-7). Based on a review of aerial photography, the repair shop property was converted to a parking lot sometime between 2006 and 2015.

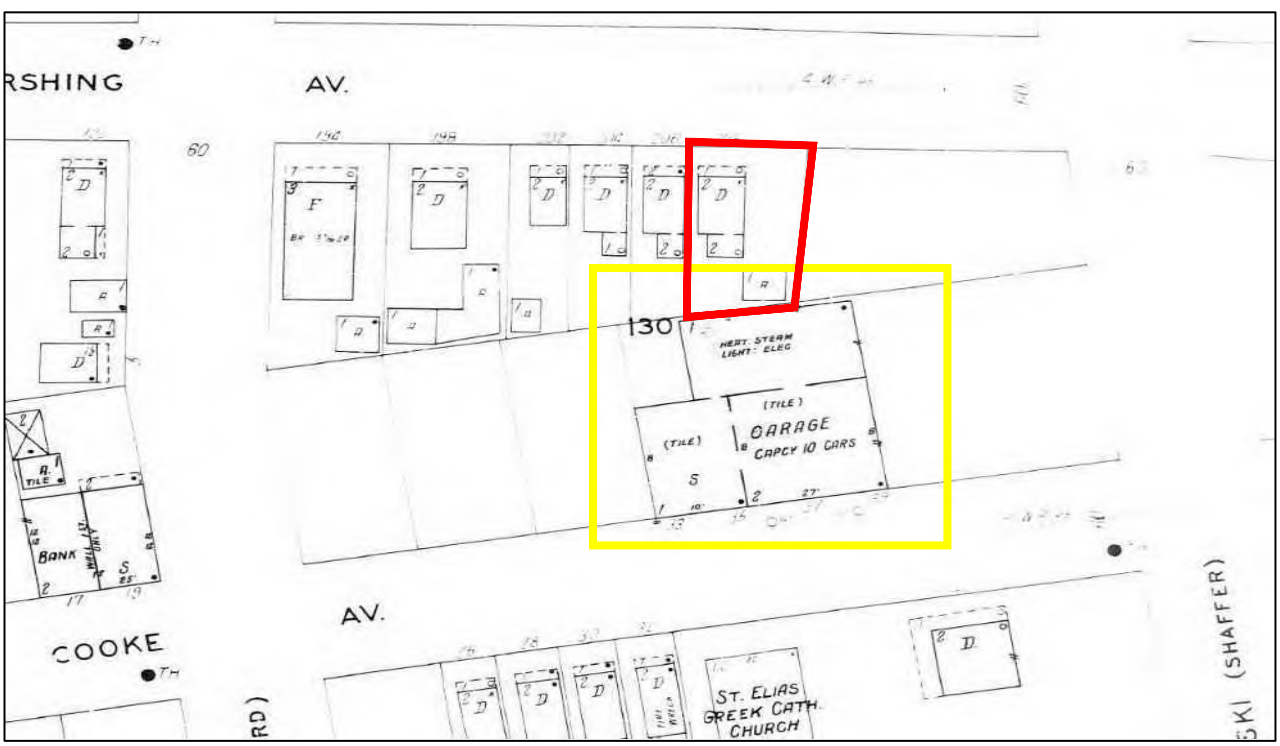

Figure 9-5. 1931 Sanborn of PPIN 7355

Figure 9-6. 1966 Aerial of PPIN 7355

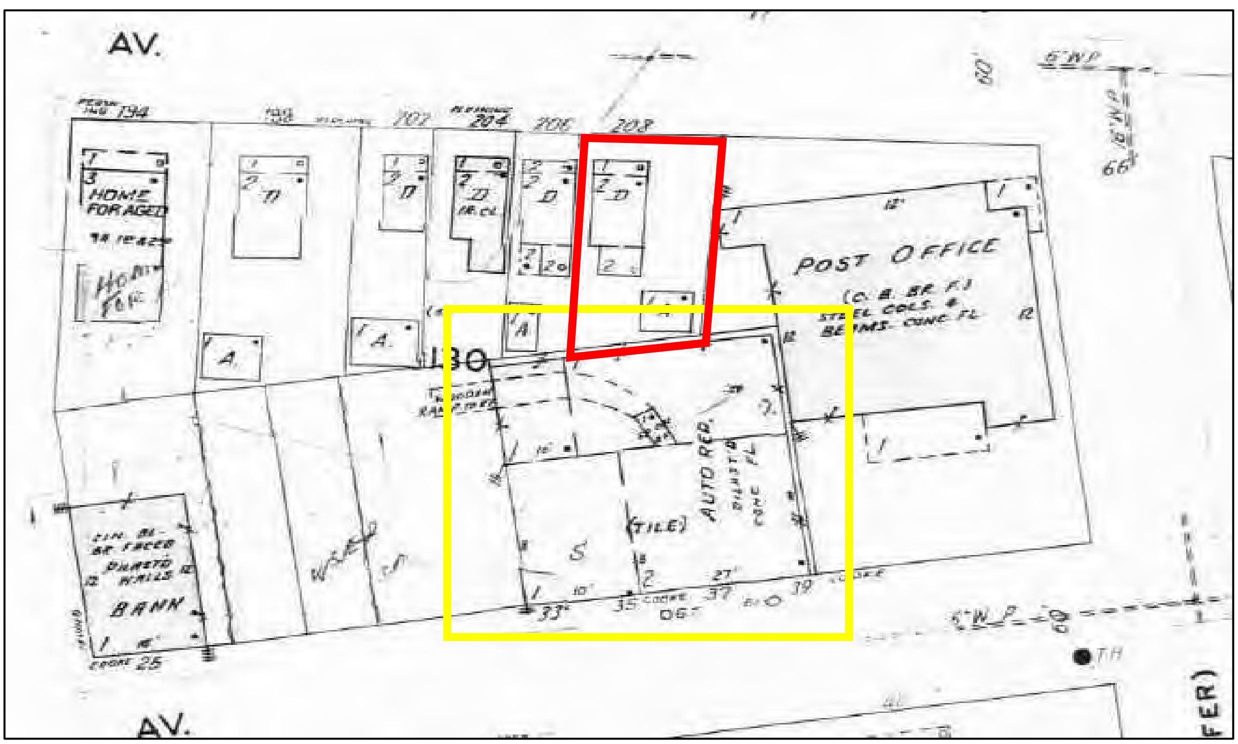

Figure 9-7. 1969 Sanborn of PPIN 7355

Fill and non-native materials were observed in 12 samples collected from PPIN 7355. Fill materials noted in the boring logs include gravel, coal, cinders, and ash. During his microscopy work, Mattingly observed paint chips in a soil sample from PPIN 7355 (Figure 9-8).

Figure 9-8. Photo of paint chips in soil sample 7355-B01-08-AG-G0065 (photo provided by Mr. Mattingly)

These analyses show the metals concentrations present at PPIN 7355 are the result of a unique combination of impacts from lead-based paint, adjacent commercial operations (auto shop), and the presence of fill materials. Source allocation for PPIN 7355 should be based on the evaluation of property specific evidence including: the horizontal and vertical spatial analysis of the soil sample results, metal ratio analysis of the soil samples, property construction and maintenance history, Sanborn maps of prior land use, evaluation of adjacent land historical use, boring log lithology, and microscopy the of soil samples. Each of these investigation topics is based primarily on physical and scientific evidence that is unique to this particular property.

9.1.3 - PPIN 6723 – 148 Carteret Avenue

The property at PPIN 6723, 148 Carteret Avenue, is a two-story, 1,205 square foot house built in 1941. This property is located at the end of transect two and has several samples with elevated arsenic and lead concentrations exceeding the NJ SRS level. Soil data from PPIN 6723 is summarized below in Table 9-3. Due to the small size of the front yard at PPIN 6723, samples were collected in the back yard only.

Table 9-3. Summary of Samples from PPIN 6723

	Arsenic	Copper	Lead
Minimum (ppm)	13.2	72.7	88.2
Average (ppm)	20.4	142.3	417.2
Maximum (ppm)	29.4	206	2180
Samples > NJ SRS	9	0	5

Based on observations from the street-level inspection of the property, the current exterior type appears to be 100% siding. During the property inspection, a shed was observed in the back yard of the property. No peeling paint was observed, although the samples with above 1,000 mg/kg lead were collected adjacent to the house.

Fill and non-native materials were observed in two samples collected from PPIN 6723. Paint chips were observed in one sample and solder spheres (likely arising from construction or repair of plumbing within the residence), which contain lead, were observed in another sample. The solder spheres have a very distinctive appearance under the microscope as shown Figure 9-9, reproduced from Figure 27 of Mr. Mattingly's report, and are composed almost entirely of lead and tin.[170]

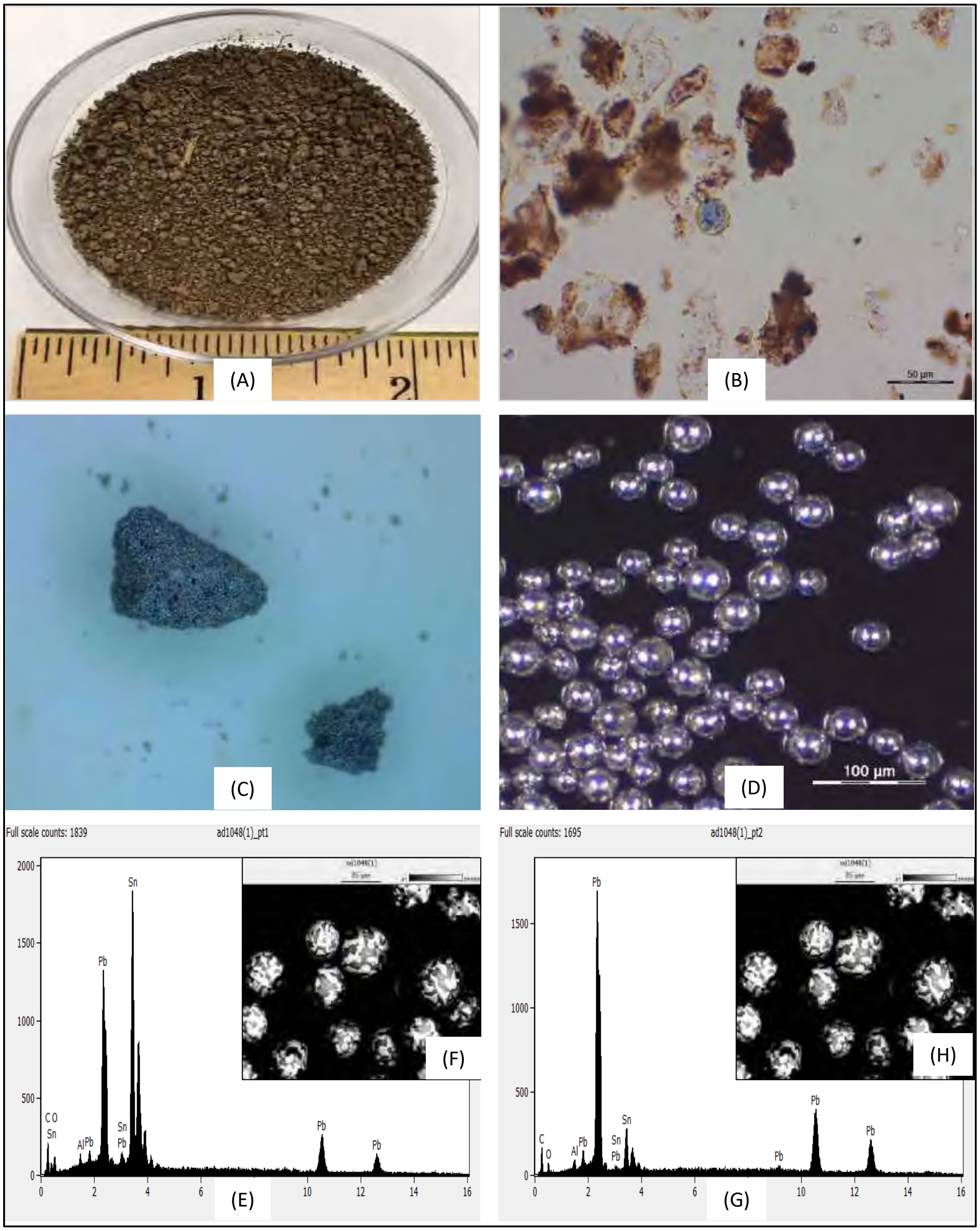

Figure 9-9. North Transect Soil Sample 6723-B01-01-AG-G0001: (A) photo; (B) stereo microscopy photomicrograph 7X; (C) stereo microscopy photomicrograph 20X; (D) stereo microscopy photomicrograph 200X; (E) broad scan solder sphere EDS spectra and (F) SEM image; and (G) focused scan of solder sphere EDS spectra and (H) SEM image.

These analyses show the metals concentrations present at PPIN 6723 are the result of a unique combination of impacts from lead-based paint, construction debris (solder spheres), and the presence of fill materials. Source allocation for PPIN

[170] Mattingly, 2019. Pg. 49/64.

6723 should be based on the evaluation of property specific evidence including: the horizontal and vertical spatial analysis of the soil sample results, metal ratio analysis of the soil samples, property construction and maintenance history, Sanborn maps of prior land use, evaluation of adjacent land historical use, boring log lithology, and microscopy the of soil samples. Each of these investigation topics is based primarily on physical and scientific evidence that is unique to this particular property.

9.1.4 - PPIN 2010 – 76 Union Street

The property at PPIN 2010, 76 Union Street, is a two-story, 1,007 square foot house built in 1900. This property is located within the AOC. A total of 73 samples were collected from PPIN 2010 at depths ranging from 0-6 inches bgs to 30-36 inches bgs. Samples collected from PPIN 2010 have numerous samples with elevated arsenic and lead concentrations exceeding the NJ SRS level. Soil data from PPIN 2010 is summarized below in Table 9-4.

Table 9-4. Summary of Samples from PPIN 2010

	Arsenic	Copper	Lead
Minimum (ppm)	4.6	8	12.2
Average (ppm)	33.1	483.1	871.6
Maximum (ppm)	102	1920	2960
Samples > NJ SRS	47	0	47

The exterior of PPIN 2010 appears to be 100% vinyl siding, and a small shed is present in the back yard.

Fill/non-native materials were observed in 24 of the samples collected from PPIN 2010. Fill materials noted in the boring logs include ash, coal, gravel, wood, asphalt, concrete, and glass. In addition, excavation of this property identified multiple fill layers. Observations during the remediation excavation of the property included paint chips visible within the excavated soil. Additionally, up to four distinct layers of fill materials were observed during the excavation (Figure 9-10, reproduced from Figure 11 of Mattingly's report). [171]

[171] Mattingly, 2019. Pg. 33/64.

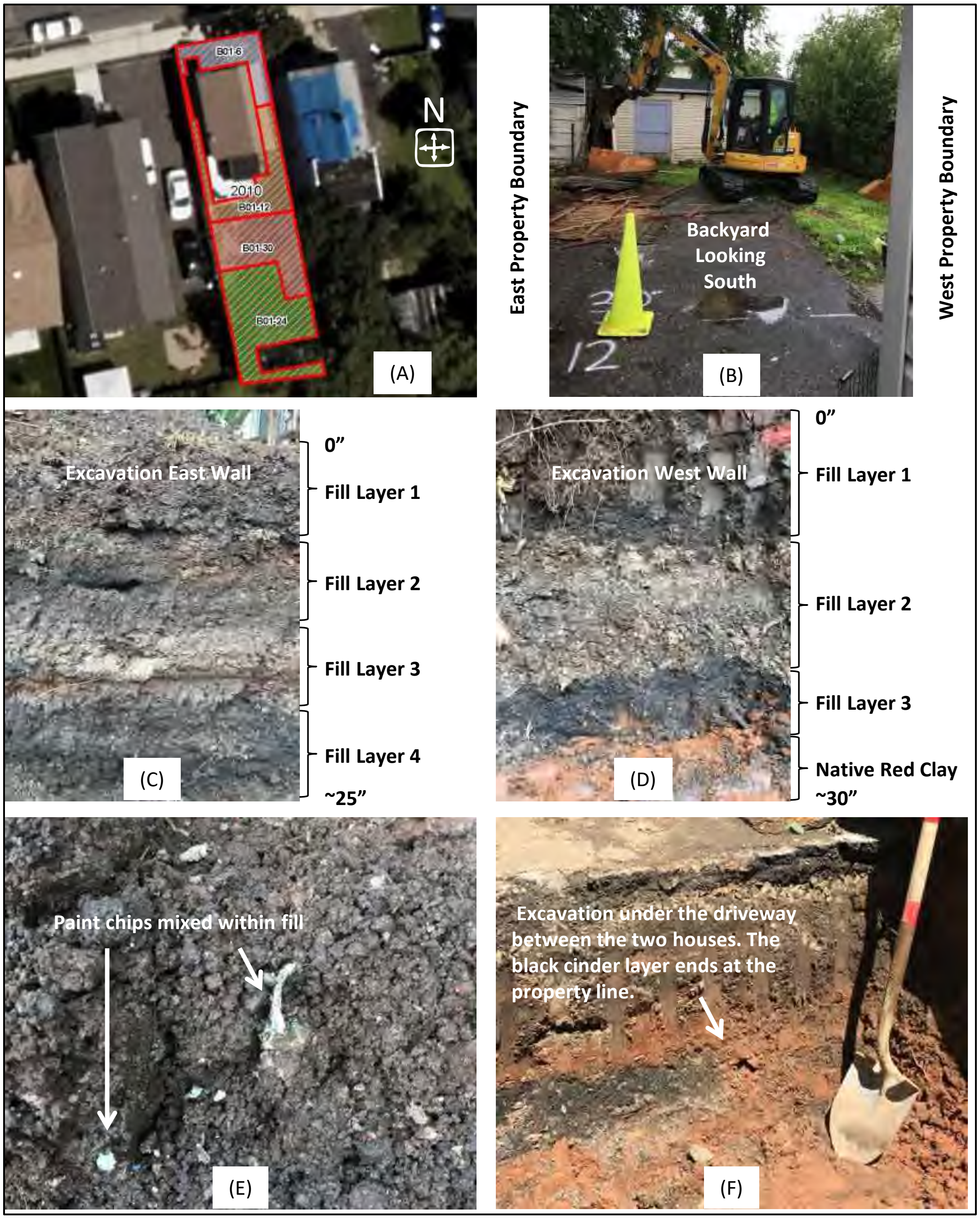

Figure 9-10. Variable Fill Layers at 76 Union St. (PPIN 2010): (A) excavation site layout; (B) backyard looking south; (C) east and (D) west walls of excavation; (E) paint chips mixed with fill; and (F) black cinder layer ends at the property line.

These analyses show the metals concentrations present at PPIN 6723 are the result of a unique combination of impacts from lead-based paint, construction debris (solder spheres), and the presence of fill materials. Source allocation for PPIN 2010 should be based on the evaluation of property specific evidence including: the horizontal and vertical spatial analysis of the soil sample results, metal ratio analysis of the soil samples, property construction and maintenance history, Sanborn maps of prior land use, evaluation of adjacent land historical use, boring log lithology, and microscopy the of soil samples. Each of these investigation topics is based primarily on physical and scientific evidence that is unique to this particular property.

9.2 Duarte Property

Conditions at the Duarte property, the named plaintiff in this case, also illustrate the unique features impacting the source of metals for each individual residential property. A review of Sanborn maps shows that tenements were present on the property in 1908 (Figure 9-11). These tenements are present through the 1969 Sanborn map. Based on available tax parcel data, the tenement housing was demolished at some point between 1969 and 1972 and the Duarte's current house, 3-A Salem Avenue, was constructed in 1972. The history of this property with an original structure built prior to 1908 and demolition of the original structure and construction of the current residence in 1972 is not typical of the construction history of the proposed class area.

Additionally, this construction, demolition, and re-development cycle likely resulted in the deposition of arsenic, copper, and lead-containing materials in the surrounding soils. Given that the original tenement housing was constructed in the early 1900s, it almost certainly had LBP. The structure was demolished in the early 1970s, prior to the implementation of procedures for mitigating LBP during demolition projects. Therefore, it can be expected that LBP and other metals-bearing materials sloughed off onto surrounding soils during the demolition process.

Sixteen soil samples collected from the Duarte property had indications of fill or other non-native materials, many of which also had elevated levels of arsenic, copper, and/or lead. Fill materials were observed in samples collected from the surface (0-6") down to 36-42 inches below ground surface. This is indicative of the disturbance caused during re-development of the property. Indicators of fill materials included in the boring logs include:

- Cinders/coal
- Concrete
- Red brick
- Glass
- Debris
- Asphalt
- Wood

The highest concentrations of lead and arsenic in soil at the Duarte property were from samples collected at depth. The maximum concentration of lead from the property (2,740 ppm) was collected from a depth of 18-24 inches and the maximum arsenic detection (73.4 ppm) was collected from a depth of 30-36 inches. Given the depth of these samples, these concentrations are not the result of aerial deposition. Rather, the concentrations observed at the Duarte property are the result of fill and re-development of the property.

The maximum copper concentration from the property (3,030 ppm) was collected at the surface in the 0-6 inch depth interval. However, this sample was collected adjacent to a chain link fence surrounding the property and the ratio of copper to the other metals was 88%. An XRF sample of a metal fence post on the Duarte property collected during the property inspection had a copper concentration of 13,300 ppm.[172] Given the proximity of this sample to the fence, this concentration is likely the result of metals from the chain link fence and not aerial deposition from the former USMR facility.

Soils at the Duarte property were excavated for remediation during the week of June 10, 2019. The excavation area was inspected for the presence of fill materials. During the excavation, a nearly 1-foot thick layer of fill materials was observed between approximately 2 and 3 feet bgs. Additionally, at the base of the excavation, the footprint of the original tenement housing was visible. Photos from the excavation are shown below in Figure 9-12 (reproduced from Figure 10 of Mattingly report).[173]

[172] Litherland, 2018. Pg. 6/41

[173] Mattingly, 2019. Pg. 32/64.

In summary, the features discussed above show that the Duarte property is unique even when compared to surrounding properties:

- Unlike most other properties within the AOC that were constructed in the early 1900s, the Duarte property was constructed in 1972 after demolition of the previous tenement housing present at the property since at least 1908.
- Also unlike most other properties within the AOC (as well as the proposed class area), the property excavation shows the Duarte property was constructed on top of demolition debris from the original tenement housing.
- Eighty percent of the soil samples collected from the Duarte property had indications of fill or other non-native materials. Brick, glass, debris, concrete, and wood were all noted in the soil boring logs from the Duarte property.
- Soil results from the Duarte property show the highest concentrations of arsenic and lead are found at depth and are the result of fill and re-development of the property.

Figure 9-11. 1908 Sanborn of Duarte property

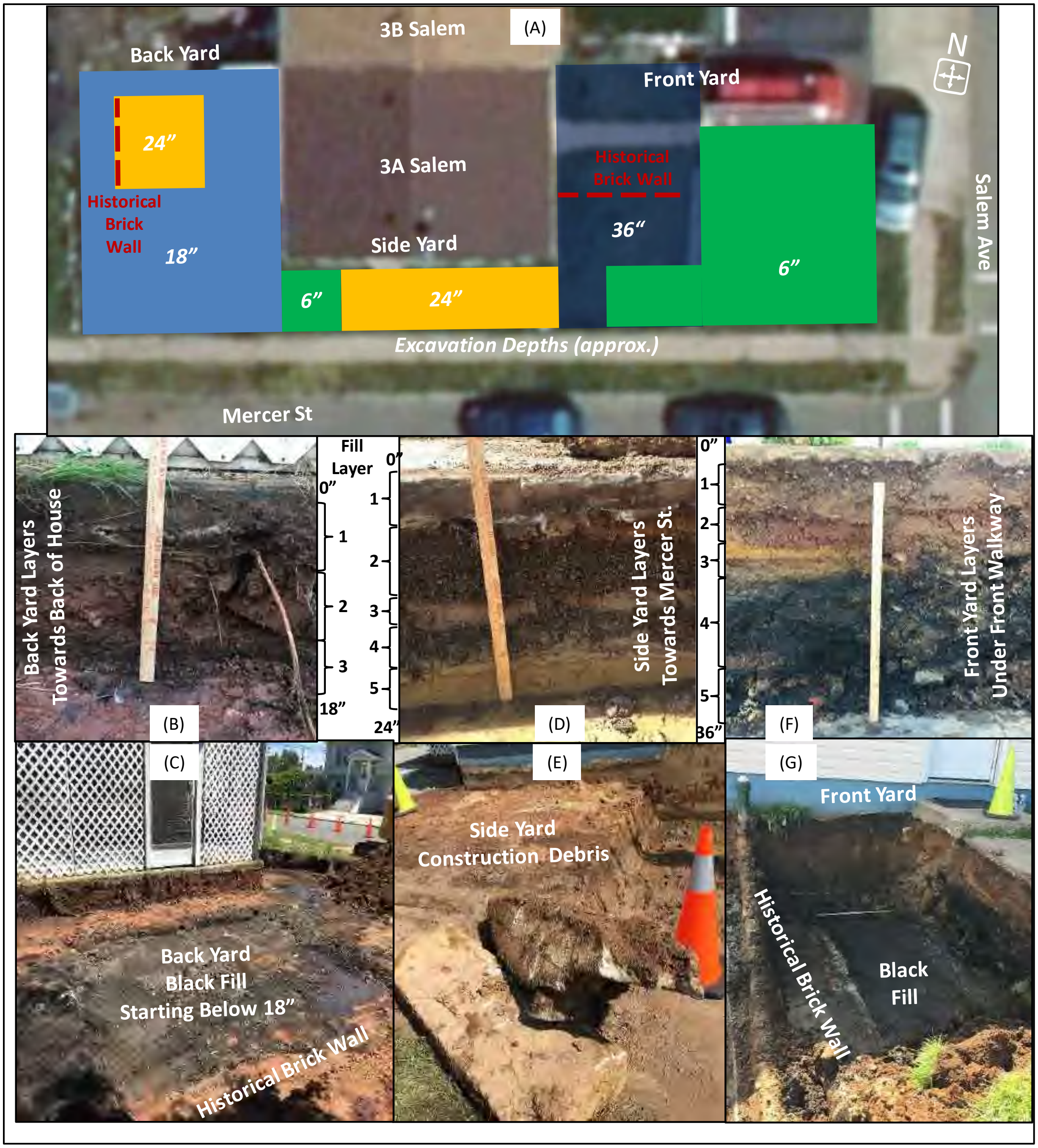

Figure 9-12. Photos of excavation from Durate property showing remnants of previous structure and fill material (Figure 10 from Mattingly report).

10.0. Rebuttal of Plaintiffs' Experts

This rebuttal section responds to several issues raised in the reports submitted by the experts for the plaintiffs; it is not a comprehensive response to their opinions.

10.1 Expert Report of Dr. George Flowers

Figure 20B in Flowers' report shows lead concentrations plotted against distance for the AOC, transect, and plaintiff samples. In his report, Flowers claims his Figure 20B shows that lead concentrations decrease with distance from the source. Upon closer inspection of the figure, Figure 20B actually shows three populations of the data: the data collected from the AOC in blue, the USMR transect data (from approximately 0.6 to 1 miles and outlined in orange) and the plaintiff data (samples greater than 1 mile and outlined in yellow). Based on trend analysis by Shahrokh Rouhani, the lead data from the AOC does show a decreasing trend. However, the transect data shows an increasing trend in lead concentrations between 0.6 and 1 miles. Past one mile, the data shifts to a slight decreasing trend. These three distinct trends indicate three data populations which points to multiple sources, and not one single source alleged by Flowers.

Additionally, Flowers fails to account for the age of housing and impacts from LBP in his trend analysis. Due to the development pattern of Carteret, there is a wide variation in housing ages in Carteret. Generally, the AOC represents some of the oldest housing in the borough, and housing ages decrease as one moves north and west away from the AOC.

Flower's examination of only one variable, distance from the former USMR facility, ignores the influence of the distribution of home construction age with distance from the former USMR facility. The newer homes, with associated lower concentrations of lead due to the lower loading from LBP are more frequent at greater distance from the former USMR facility (see Figures 7-7A and 7-7B). The oldest homes built before 1910 with the highest yard concentrations of lead are all within 5,000 feet of the former USMR facility. By contrast, almost all of the homes beyond 7,000 feet are newer homes built after the late 1950s, with corresponding lower levels of lead from LBP. The intermediate zone from 5,000 to 7,000 feet has a mixture of homes ages with about one-third built between 1900 and 1940, one-third between 1940 and 1953, and one-third after 1953. This mixture would produce, from LBP loading variability alone, values between the nearer, older grouping of homes, and the more distant, newer grouping of homes.

Without any statistical analysis whatsoever, at least a modest decreasing trend would be expected due to the skew in the home ages with distance. Any trend is not related to distance from the former USMR facility, but an artifact of the age profile of the homes.

I have reproduced Flowers' Figure 20B below identifying the three distinct datasets. As noted above, in general the AOC represents the oldest housing, followed by the transects, and then the plaintiff properties, which are in the more recently developed portion of the class. This is illustrated by the median year of construction. The transect properties have a median year of construction of 1918, while the plaintiff properties have a median year of construction of 1953. While LBP was still in use in 1953, it contained significantly less lead than paint from 1918.[174] Therefore, the variations in lead concentrations shown in Flowers' Figure 20B can be explained by the age of housing and development patterns in Carteret and are not the result of aerial deposition from the former USMR facility.

[174] Sabin, 1919.

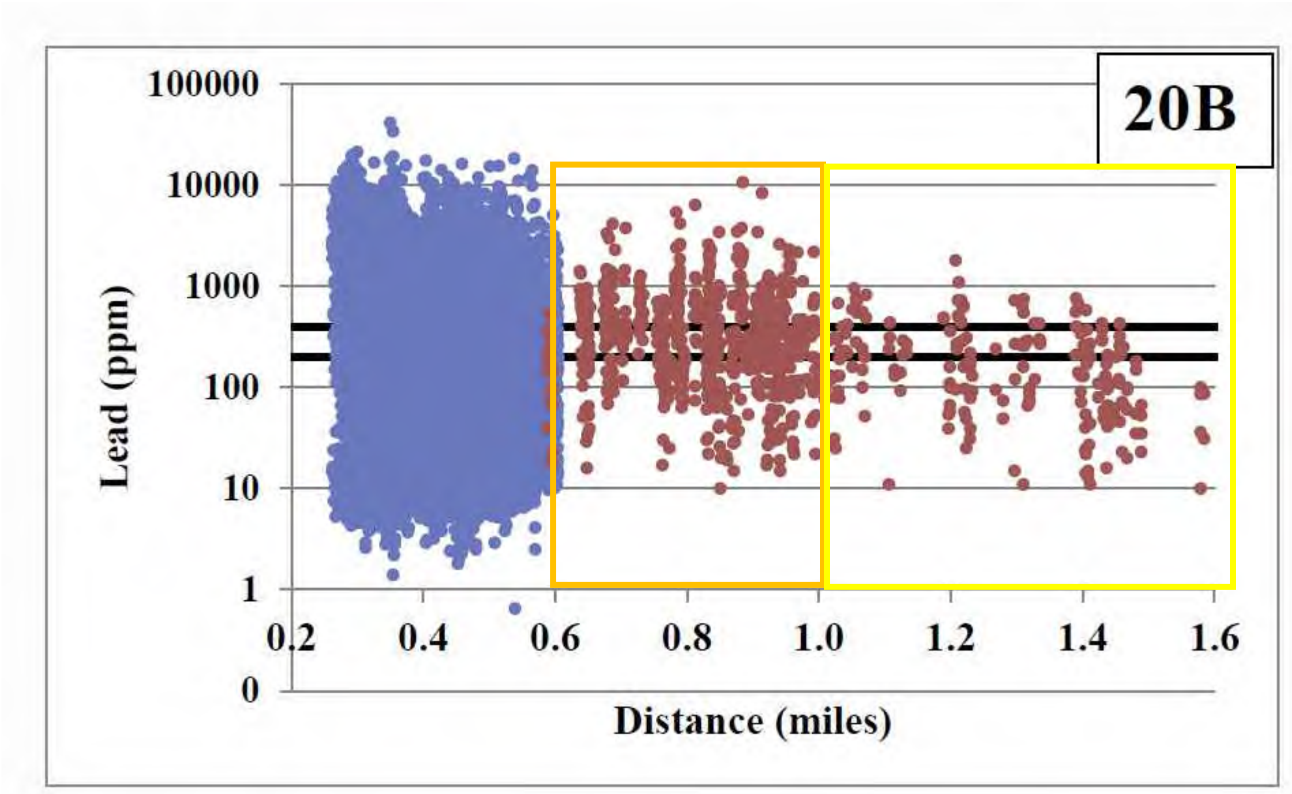

Figure 10-1. Flowers' Figure 20B.

10.2 Expert Report of Mr. David Sullivan

In his expert report, Sullivan modeled concentrations of lead in soil based on three modeled scenarios of emissions from USMR. Sullivan's original Figure 16 (which Flowers also included in his report as Figure 27) shows the surface (0-6 inch) lead concentrations (presumably the median concentration per property) for the AOC and transect properties overlain with modeled soil concentrations of lead represented as isopleths. Sullivan's amended expert report shows the same surface lead data overlain by his revised model results in Figure 16c of his report. In Section 6.6.1 of both his original and amended report, Sullivan concludes that "the general pattern and decrease of modeled soil concentration with distance from USMR are reasonably consistent with the measured soil contamination data."[175] In reaching this conclusion, Sullivan fails to consider other sources of lead within the proposed class, specifically LBP.

The variation observed in lead concentrations in the USMR and plaintiff transect samples is a function of the age of housing, and not distance from the former USMR facility (Figure 10-2). This is best displayed by the data from the central transect. The increase in lead concentrations observed between 3,000 and approximately 4,000 feet from the former USMR facility coincides with an increase in the age of the houses. Conversely, the decline in lead concentrations between 4,000 and 6,500 feet corresponds to a decrease in the age of housing. These same patterns are observed in the western and eastern transect. The eastern transect passes through much older housing stock than the other two transects, and as a result, lead concentrations remain consistent throughout the transect.

Sullivan claims that the modeled soil concentrations are "reasonably consistent" with the measured soil concentrations. However, Figure 10-2 shows that this conclusion is also flawed. The isopleths shown in Figure 10-2 correspond to Sullivan's modeled soil concentrations from his Figure 16c. The chart in Figure 10-2 show that the observed soil concentrations are not at all consistent with Sullivan's model. Additionally, observed soil concentrations are substantially higher than those predicted by his model in all three transects. The patterns observed in soil lead concentrations in all three transects show that the soil lead concentrations are not the result of aerial deposition from the former USMR facility. Rather, based on the correlation with age of housing, are the result of impacts from LBP. For

[175] Sullivan, 2019c. Pg. 51/81.

the same reason, the soil data do not support Sullivan's conclusions regarding USMR facility impacts throughout and beyond the class area.

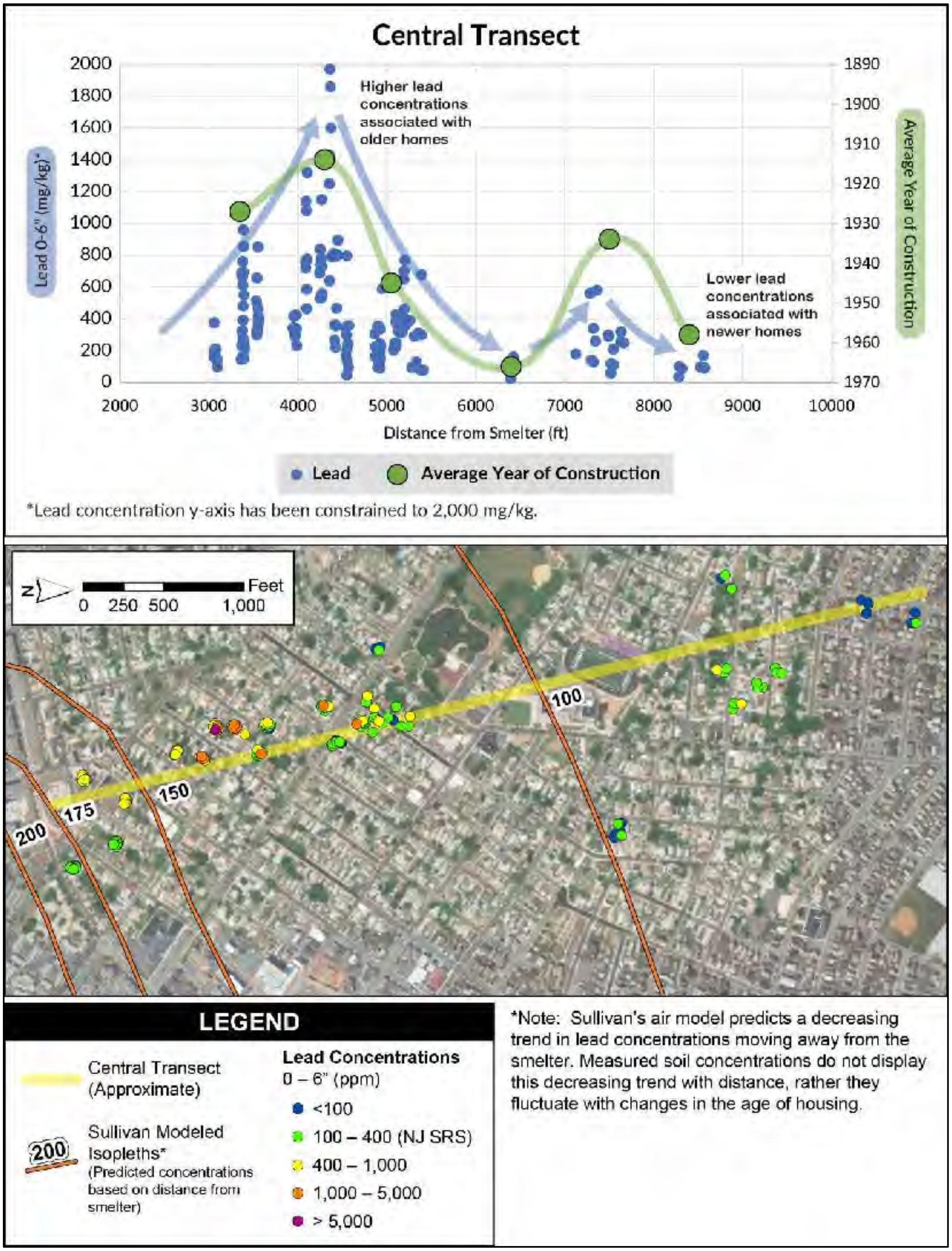

Figure 10-2. Lead Concentrations and Age of Housing in Central Transect

11.0. Documents Relied Upon

AMAX, 1988. Remedial Investigation. February 28, 1988.

Asbury Park Press, 1926. “Flower Garden Tools”. May 6, 1926.

Asbury Park Press, 1960. “Cankerworms Are Pests”. May 8, 1960.

Asbury Park Press, 1960b. “Spray Trees at Bud Break”. April 24, 1960.

Ash, J. and Matsumoto, K. 2010. A survey of typical arsenic and lead concentrations in soil in railroad corridors. Presented at the 103rd Air and Waste Management Association, Calgary, Alberta, Canada. June 22-25, 2010.

Arcadis, 2016a. Off-Site AOC Remedial Investigation Report. May 2016.

Arcadis, 2016b. Remedial Action Work Plan Addendum – Boundary Evaluation Soil Sampling Program. November 2016.

ATSDR, 2007. Toxicological Profile for Arsenic. August 2007.

Brown, R.W., C. Gonzales, M. Hooper, A. Bayat, A. Fornerette, T. McBride, T. Longoria, H. Mielke, 2008. Soil lead in residential transects through Lubbock, Texas: a preliminary assessment. Environmental Geochemical Health 30: 541-547. June 2008.

Camden Courier Post, 1931. Find Beetle Damage in South Jersey. May 7, 1931.

Carteret Press. 1928. “Fire Protection Now Assured in East Rahway and Boulevard”, October 19, 1928.

Carteret Press. 1930. “Thieves Steal Lead”, November 14, 1930.

Carteret Press. 1956. “About Your Home”, April 27, 1956.

Central Jersey Home News, 1935. “Your Garden This Week”, July 21, 1935.

Central Jersey Home News, 1936. “Arsenate Kills Canker Worms”, May 10, 1936.

Central Jersey Home News, 1945. “Your Garden This Week”, July 29, 1945.

Clark, J. and A. Knudsen. 2014. Extent, Characterization, and Sources of Soil Lead Contamination in Small-Urban Residential Neighborhoods. American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America.

De Angelo, W.A. n.d. The History Buff’s Guide to Middlesex County. http://www.middlesexcountynj.gov/Government/Departments/BDE/Documents/history_buffs_guide.pdf

Deposition of Mr. Joe Brunner. June 6-7, 2018.

Deposition of Dr. George Flowers. June 14, 2019.

Deposition of Dr. Jeff Kurtz. December 13, 2018.

Deposition of Michael McNally. August 17, 2018.

Deposition of Mr. David Sullivan. June 11, 2019.

Deposition of Ms. Lisa Szegedi. November 28, 2018.

ELM, 2016. Remedial Investigation report. May 5, 2016.

Flowers, G. 2019a. Expert Report of George Flowers: The USMR Smelter: Impact on Carteret, New Jersey Soils. May 6, 2019.

Flowers, G. 2019b. Revised Expert Report of George Flowers: The USMR Smelter: Impact on Carteret, New Jersey Soils. June 10, 2019.

Gravel, A.J., 2018. Presentation: Overview of Alternate Sources of Copper, Lead, and Arsenic. October 26, 2018.

Gravel, A.J., 2019. Expert Report of A.J. Gravel. July 3, 2019.

Folkes, D., S. Helgen, and R. Litle. 2001. Impacts of historical arsenical pesticide use on residential soils in Denver, CO. In: Chappell, W.R., eds. Arsenic Exposure and Health Effects. Elsevier Science.

Folkes, D. 2010. Contributions of pesticide use to urban background concentrations of arsenic in Denver, CO. Environmental Forensics 2(2): 127-139.

Gooch, J. 1993. Lead-based Paint Handbook. First edition. New York, NY: Springer Science+Business Media.

Hills, J., B. Morgan, A. Dunham, and J. Rue. 1781. Map of Middlesex County. US Library of Congress. https://www.loc.gov/item/gm72003603/

Litherland, S. 2018. Sampling – Carteret, NJ. June 21, 2018.

Mattingly, S. 2019. Expert Report of Stephen Emsbo-Mattingly. July 5, 2019.

Mielke, H., D. Dugas, P. Mielke, K. Smith, and C. Gonzales. 1997. Associations between Soil Lead and Childhood Blood Lead in Urban New Orleans and rural LaFourche Parish of Louisiana. Environmental Health Perspectives, 105, 950-954.

Mielke, H. and P. Reagan. 1998. Soil Is an Important Pathway of Human Lead Exposure. Environmental Heath Perspectives 106 (Suppl 1), 217-229.

Mielke, H., C. Gonzales, M. Smith, and P. Mielke. 1999. The Urban Environment and Children's Heath: Soils as an Integrator of Lead, Zinc, and Cadmium in New Orleans, Louisiana. Environmental Research, 80, 117-129.

Murphy, E. and M. Aucott, 1998. An Assessment of the Amount of Arsenical Pesticides Used Historically in a Geographical Area. The Science of the Total Environment 218:89-101.

National Library of Medicine Hazardous Substances Database (HSDB). Chromated Copper Arsenic. January 15, 2015.

NJDEP. n.d. Historical Fill Material and Diffuse Anthropogenic Pollutants Technical Guidance. https://www.nj.gov/dep/srp/srra/training/sessions/hf_historic_fill_111116.pdf

NJDEP. 2018. DGS04-7 Historic Fill for New Jersey As of March 2018. NJ Department of Environmental Protection, Division of Water Supply and Geoscience.

NJGIN, 2019. Known Contaminated Site List for New Jersey. https://njogis-newjersey.opendata.arcgis.com/datasets/njdep::known-contaminated-site-list-for-new-jersey-non-homeowner

Otley, J.W., J. Keily, L. Van Derveer, E. Herline, and A.C. Stansbie. 1850. Map of Middlesex County, New Jersey. US Library of Congress. https://www.loc.gov/item/2004629245/

Rabin, R. 1989. Warnings Unheeded: A History of Lead Poisoning. American Journal of Public Health, 79, 1668-1674.

Reich, P. 1992. The Hour of Lead: A Brief History of Lead Poisoning in the United States Over the Past Century and of Efforts by the Lead Industry to Delay Regulation. Environmental Defense Fund. June 1992.

Rosenfeld, P. 2019. Preliminary Assessment Report for Class Certification of Residential Properties with Metals Contamination from the U.S. Metals Refining Company Facility in Carteret, New Jersey. May 2019.

Rouhani, S. 2019. Expert Report of Dr. Shahrokh Rouhani. July 1, 2019.

Sabin, A.H. 1920. Red-Lead and How to Use It In Paint, Third Edition. New York: John Wiley & Sons, Inc.

Sabin, A.H. 1920. White-Lead: Its Use in Paint. New York: John Wiley & Sons, reprinted by the University of Michigan Libraries.

Sanborn Map Company, 2017. Sanborn Fire Insurance Maps. https://www.sanborn.com/sanborn-fire-insurance-maps/, accessed 6/10/2019.

Schwarz, K. R. Pouyat, and I. Yesilonis. 2016. Legacies of Lead in Charm City's Soil: Lessons from the Baltimore Ecosystem Study. Environmental Research and Public Health, February 2016.

Sheets, R.W. 2001. Relationship between soil lead and airborne lead concentrations at Springfield, Missouri, USA. The Science of the Total Environment, 271, 79-85.

Stook, K., T. Tolaymat, M. Ward, B. Dubey, T. Townsend, H. Solo-Gabriele, and G. Bitton. Relative leaching and aquatic toxicity of pressure-treated wood products using batch leaching tests. Environmental Science and Technology 39(1): 155-63. January 2005.

Stout, K. 2019. Historical Agricultural Study, Carteret, NJ – Expert Report. June 28, 2019.

Sullivan, D. 2019a. Expert Report – Air Deposition Analysis Related to USMR Smelter Operations in the City of Carteret, New Jersey. May 4, 2019.

Sullivan, D. 2019b. Supplemental Expert Report - Air Deposition Analysis Related to USMR Smelter Operations in the City of Carteret, New Jersey. June 7, 2019.

Sullivan, D. 2019c. Amended Expert Report - Air Deposition Analysis Related to USMR Smelter Operations in the City of Carteret, New Jersey. June 28, 2019.

Szegedi, L. 2019. Expert Report of Lisa Szegedi, Statistical Evaluations Related to the United States Metals Refining Company (USMR) Smelter Operations, Carteret, New Jersey. June 28, 2019.

Tucker, P., P. Douglas, A. Durrant, and A.S. Hursthouse. 1999. Heavy metal content of newspapers: longitudinal trends. Environmental Management and Health 11(1):47-66. January 1999.

USEPA, n.d. Facility Registry Services. https://iaspub.epa.gov/sor_internet/registry/facilreg/home/overview/home.do

USEPA, 1995. Report on the National Survey of Lead-based Paint in Housing. HUD Contract Number HC-5848 and EPA Contract Numbers 68-D9-0174, 68-D2-0139, and 68-D3-0011. June 1995.

USEPA, 2008. Construction Initiative: Supporting Green Design in Construction though Industrial Materials Recycling. Office of Solid Waste and Emergency Response, EPA530-F-08-013. June 2008.

The Vinyl Siding Institute, 2012. About Vinyl Siding. Vinylsiding.org, retrieved 10/12/2012.

Washington Department of Ecology, 2006. Environmentally Preferable Product Report: Alternatives to Arsenic-Treated Wood. Publication number 06-04-023. October 2006.

12.0. CV

WILLIAM L. HALL, P.E.

Chairman of the Board
NewFields Companies
1349 W. Peachtree Street, Suite 2000
Two Midtown Plaza
Atlanta, GA 30309
bhall@newfields.com | 404-347-9050

EXPERIENCE SUMMARY

Mr. Hall is the Chairman of the Board of NewFields Companies, LLC, a firm that specializes in decision analysis and comprehensive data analysis for resource management, land restoration, impact mitigation and remediation. Mr. Hall's specialty is data and environmental systems analysis, decision analysis, industrial waste management history, remediation system design, and strategic planning. He holds a Bachelor in Civil Engineering from the Georgia Institute of Technology and has over 45 years of experience in characterization, analysis and design in environmental resource management.

His background includes extensive applied experience in remediation engineering, geology, geochemistry, hydrogeology, surface water hydrology, spatial statistics, pattern analysis, and systems based management of human interactions with environmental systems. In addition Mr. Hall has worked on well over 1000 restoration and resource development projects in the US and over 50 countries. He has worked on the design of regional water resource management systems throughout the US, Australia, the Middle East, and Africa. His experience in the field of remediation and restoration includes the characterization and remediation of pesticides, metals, petroleum hydrocarbons, solvents, PCBs, and Dioxins. He has also served as the data pattern analyst and decision analyst on over 50 expert technical review panels for the US Army, US Air Force, and US Navy. These panels have addressed the state of the art for identifying contaminant fate and transport and management alternatives for specific applications on military bases throughout the US and the Pacific.

Mr. Hall has provided environmental data analysis and strategic planning for the private, public, and NGO sectors. Private sector clients include companies such as Shell Oil, DOW Chemical, Exxon, Chevron, Eli Lilly, Bayer, Freeport– McMoRan, Halliburton, and Olin Corporation. Public sector clients include the US Parks Service, Forest Service, DOD and local municipalities. His NGO clients are primarily environmental advocacy organizations. His firm has worked extensively with the World Bank on international resource development projects and he has provided technical assistance to the Environmental Defense Fund, Riverkeepers, the Southern Environmental Law Center, and GreenLaw.

Mr. Hall and Dr. Shahrokh Rouhani established NewFields in 1995. The firm currently has 20 offices and an International Division with projects in over 70 countries and offices in Brazil, Mexico, Canada, and the European Union. The firm was established to focus on resolution of environmental issues involving the interaction of multiple disciplines and complex extensive data histories. Prior to founding NewFields Mr. Hall was a Partner in the international engineering firm of Dames & Moore.

REGISTRATIONS AND PROFESSIONAL AFFILIATIONS

Professional Engineer, State of Georgia
Professional Engineer, State of Alabama
American Society of Civil Engineers
American Society of Professional Engineers

EDUCATION AND TRAINING

B.S., Highest Honors, Civil Engineering, Georgia Institute of Technology, 1974
Graduate work in hydrologic and hydraulic modeling and analysis, sedimentation, water resources management, and limnology

REPRESENTATIVE PROJECT EXPERIENCE (The following listing is not exhaustive)

Cost Allocation Projects

The following table provides an overview of Mr. Hall's experience in cost allocation for hazardous waste cleanup and environmental defense indemnity, and natural resource damage.

Project	Client	Description	Contaminants
Sykes Landfill	Atlantic Richfield	Superfund disposal site cost allocation – >100 PRPs	PAHs, PCBs, Solvents
Jacksonville Oil Terminal	Shell Oil	Superfund site cleanup – 4 PRPs	PAHs, Solvents
Lower Duwamish River	Ash Grove Cement	Superfund sediment cleanup – 30 PRPs	PCBs
Solvent Chemical Niagara New York	Olin Corporation	Superfund Sediment and Groundwater Cleanup – 3 PRPs	Mercury, solvents,
MDG Manufacturing– Sao Paulo	General Electric	Superfund Equivalent mixed use soil and groundwater contamination – private and government entities	PCBs, mercury, solvents
Olin Insurance litigation	Olin Corporation	25 sites – Superfund, RCRA, State Superfund – multiple insurance carries – 3 Chlor-alkali facilities	Solvents, organic chemicals, mercury, PCBs
Eli Lilly Insurance Litigation	Lilly Corporation	6 Superfund and RCRA sites, soil, groundwater and sediment-multiple insurance carriers and PRPs	Solvents, organic chemicals, mercury, PCBs
Crab Orchard Wildlife Refuge	Olin Corporation	33 Superfund sites-soil, groundwater and sediment – multiple groups of PRPs	Solvents, organic chemicals, mercury
Turtle Bayou	Shell Oil	Numerous disposal pits– >100 PRPs	Solvents, organic chemicals, mercury
Sturbridge Massachusetts Water District	Shell Oil	State Superfund site 4 PRPs – soil and groundwater	MTBE
Brown and Bryant	Shell Chemical	2 pesticide manufacturing facilities – 3 PRPs	Pesticides/metals
Del Amo Superfund site	Shell Chemical	Synthetic rubber plant – 10 PRPs	Solvents/butadiene/styrene
Patrick's Bayou	Shell Chemical	Refinery and chemical facility	Mercury, PCBs, PAHs
Anniston Lead Site	Phelps Dodge	Multiple iron/brass foundries	Lead and PCBs

HAZARDOUS WASTE MANAGEMENT EXPERIENCE

The following table provides an overview of Mr. Hall's hazardous waste management experience in terms of clients, types of projects, and contaminants addressed. The list is not exhaustive as he has worked on over a thousand sites in approximately 70 countries. His role is indicated as Principal in Charge for those projects in which he served as the design engineer responsible for characterization, design, implementation and cost estimation/control. Mr. Hall's project experience includes seven color-alkali facilities, approximately 25 sites involving mercury as a primary contaminant, and over 100 sites involving sediment characterization, remediation and management.

Project/Site	Regulatory Framework	Location	Client	Contaminant	Service
Muscle Shoals Chlor-Alkali	RCRA	Alabama	Occidental Chemical Corp.	mercury	Strategic Planning / Decision Analyst/Expert Testimony

Project/Site	Regulatory Framework	Location	Client	Contaminant	Service
Niagara Falls Chlor-alkali	State Superfund	New York	Olin	mercury/solvents/ pesticides	Strategic Planning / Decision Analyst/Expert Testimony
McIntosh Chlor-alkali	CERCLA/RCRA	Alabama	Olin	mercury/solvents	Strategic Planning / Decision Analyst/Expert Testimony
LCP Chlor-alkali	CERCLA	Georgia	Honeywell	mercury	Strategic Planning / Decision Analyst
Patrick Bayou Chlor-alkali and refinery site	CERCLA	Texas	Shell and Occidental Chemical	mercury / PAHs	Strategic Planning / Decision Analyst
Sao Paulo Pesticide Manufacturing Facility& Chlor-alkali	superfund equivalent	Brasil	Shell Chemical	mercury/arsenic/ pesticides	Strategic Planning / Decision Analyst
Augusta Chlor-alkali	RCRA				Strategic Planning / Decision Analyst/Expert Testimony
Farm Chemical	CERCLA	N. Carolina	DOW, Shell Chemical	metals (arsenic)/ pesticides/solvents	Principal in Charge
Adak Island	CERCLA	Alaska	Navy	pesticides/Solvents/ metals (mercury/ arsenic)	Strategic Planning / Decision Analyst
MDG Sao Paulo	CERCLA Equivalent	Brasil	GE	arsenic/mercury/PCB/ solvents	Strategic Planning / Decision Analyst
Dahlgren landfill	CERCLA	Delaware	US Navy	mercury, PCBs	Strategic Planning / Decision Analyst
Turtle Bayou	CERCLA	Texas	Shell Oil	mercury, PCBs, PAHs	Strategic Planning / Decision Analyst/Expert Testimony
Waukegon Manufactured Gas Plant Site	CERCLA	Illinois	General Motors	mercury, PAHs	Strategic Planning / Decision Analyst/Expert Testimony
Twin Sites	CERCLA	N. Carolina	DOW, Shell, Bayer	pesticides/metals/ solvents	Principal in Charge/expert testimony
McIver	CERCLA	N. Carolina	DOW, Shell, Bayer	pesticides/metals/ solvents	Principal in Charge/expert testimony
HWY 211	CERCLA	N. Carolina	DOW, Shell, Bayer	pesticides/metals/ solvents	Principal in Charge/expert testimony
Fairway Six	CERCLA	N. Carolina	DOW, Shell, Bayer	pesticides/metals/ solvents	Principal in Charge/expert testimony
Brown and Bryant	CERCLA	California	Shell chemical	pesticides/metals (arsenic)	Strategic Planning / Decision Analyst/Expert Testimony
Del Amo	CERCLA	California		solvents/butadiene/ styrene	Strategic Planning / Decision Analyst
Anniston Lead Cleanup	CERCLA	Alabama	Multiple	lead	Strategic Planning / Decision Analyst
Crymes Landfill	State CERCLA	Georgia	Multiple	PCBs, metals, solvents	Strategic Planning / Decision Analyst
Cosmopolis, Brasil	CERCLA Equivalent	Brasil	Lilly	pesticides/herbicides	Strategic Planning / Decision Analyst
Guam (4 sites)	CERCLA		Navy	PCBs	Strategic Planning / Decision Analyst
009 Landfill & plant	CERCLA	Georgia	Hercules	pesticides/Solvents	Strategic Planning / Decision Analyst
Valley Chemical	CERCLA	Mississippi	Shell	pesticides/metals	Principal in Charge
Central Chemical	CERCLA	Maryland	Syngenta/ Shell Chemical	pesticides/metals	Strategic Planning / Decision Analyst
Shafter Pesticide Formulation	CERCLA	California	Shell Chemical	pesticides/arsenic/ solvents	Strategic Planning / Decision Analyst
Bofors Nobel	CERCLA	Michigan	DOW/Eli Lilly	solvents	Strategic Planning / Decision Analyst
Virginia Properties	CERCLA	Virginia	Rentokil-Initial	PAHs/pesticides/ metals	Principal in Charge
Sikes Disposal Pits	CERCLA	Texas	Atlantic Richfield	industrial chemicals	Strategic Planning / Decision Analyst/
Dupont Chambers	RCRA	Delaware	Dupont	industrial chemicals	Strategic Planning / Decision Analyst

Project/Site	Regulatory Framework	Location	Client	Contaminant	Service
Tex Tin	CERCLA	Texas	Southwire	lead	Strategic Planning / Decision Analyst
Elizabethtown Gas	CERCLA	New Jersey	Elizabeth Town Gas	PAHs	Strategic Planning / Decision Analyst
Chevron Refinery Portfolio	CERCLA/RCRA	Texas/California/ Pennsylvania/New Jersey	Chevron	petroleum hydrocarbons	Strategic Planning / Decision Analyst
Paulinia Pesticide Manufacturing Facility	superfund equivalent	Brasil	Shell Chemical	pesticides	Strategic Planning / Decision Analyst/detailed design
Saraland	CERCLA	Alabama	Rentokil-Initial	industrial chemicals	Principal in Charge
Red Panther	CERCLA	Mississippi	PRP Group-Syngenta	pesticides/metals	Principal in Charge
Factory Lane	State Superfund	New Jersey	Bayer/ Aventis	arsenic	Principal in Charge
Portao	RCRA equivalent	Brasil	Bayer	pesticides/solvents/ metals	Principal in Charge
Sao Pedro	CERCLA equivalent	Brasil	Bayer/ Aventis	pesticides/solvents/ metals	Principal in Charge
Sao Leopoldo	CERCLA equivalent	Brasil	Bayer/ Aventis	pesticides/solvents/ metals	Principal in Charge
Basel Landfill	CERCLA Equivalent	Switzerland	Syngenta	PCBs/Industrial chemicals/ metals	Strategic Planning / Decision Analyst
London Olympics	CERCLA equivalent	England	London Olympic Committee	industrial chemicals/ metals / etc.	Strategic Planning / Decision Analyst
Big D	CERCLA	Ohio	Olin	industrial chemicals	Strategic Planning / Decision Analyst/expert testimony
Xalostoc	superfund equivalent	Mexico	Shell Chemical	pesticides/metals	Principal in Charge
Castleford	superfund equivalent	England	Lonza	industrial chemicals	Strategic Planning / Decision Analyst

US DEPARTMENT OF DEFENSE EXPERT PANELS – Database Development, Data Analysis, Cost Estimation & Control, and Strategic Plan Development

From 1995 through 2011 Mr. Hall served as the decision analyst on DOD review panels for almost all of the major DOD facilities throughout the US and pacific rim, including Guam, Hawaii, Aleutian Islands, and Midway. Mr. Hall created the role and procedures for decision analysis for the US Navy, and the function was adopted by the US Army. Mr. Hall along with a colleague, Kandi Brown, were instrumental in the deployment of the same techniques for multiple Air Force Bases. Mr. Hall's application of Decision Consequence Analysis was adapted from the DOD work for managing portfolios in the private sectors for clients such as Chevron, Shell, Bayer Crop Protection, National Grid, Eli Lilly, Olin, General Dynamics, Rentokil Initial, Lonza, and Sanofi, among others. It has also been applied widely in numerous toxic tort and insurance litigation cases involving hundreds of sites.

The procedures developed by Mr. Hall and NewFields are documented in the textbook Sustainable Land Development and Restoration: Decision Consequence Analysis published by Elsevier Press in 2011.

FACILITIES IN WHICH MR. HALL SERVED AS DECISION ANALYST

US Army

Volunteer Army Ammunition Plant – TN

Alabama Army Ammunition Plant – AL

Tooele Army Depot – UT
Lake City Army Ammunition Plant – MO
Red River Army Depot – TX
Aberdeen Proving Grounds – MD
Fort Detrick – MD
Picatinny Arsenal – NJ
Fort McClellan – AL
Fort Gillem – GA
Schofield Barracks – HI
Rocky Mountain Arsenal – CO
Presidio – CA
Twin Cities Army Ammunition Plant – MN

US Air Force
Avon Park Air Force Range – FL
Shaw Air Force Base – SC
Beale Air Force Base – CA
Barksdale Air Force Base – LA
Moody Air Force Base – GA
Langley Air Force Base – VA
Seymour-Johnson Air Force Base – NC

US Navy
Naval Air Station Treasure Island – CA
Hunters Point Naval Shipyard – CA
Naval Air Station Alameda – CA
Marine Corps Base Camp Pendleton – CA
Naval Air Weapons Station China Lake – CA
Naval Air Station Mole Pier – CA
Naval Base Guam – Guam
Naval Surface Warfare Center Dahlgren – VA
Midway Naval Base – Pacific
Quonset-Davisville Naval Base – RI
Naval Air Station Cecil Field – FL
Naval Air Station Jacksonville – FL
Naval Ordnance Station Louisville – KY
Mare Island Naval Shipyard – CA
DOD Housing Facility Novato – CA
Naval Air Station Dallas (Mountain Creek) – TX
Washington Navy Yard – DC
Naval Security Station – DC
Pearl Harbor Naval Shipyard – HI
Naval Air Station Pearl Harbor – HI
Naval Security Group Activity Skaggs Island – CA
Adak Naval Air Station – AK
Naval Weapons Industrial Reserve Plant Bethpage – NY

The following is a representative list of portfolio wide assessments for private sector clients. Each of the projects involved development of master data bases, and portfolio wide assessment of contaminant and risk distribution patterns, comprehensive cost management, and priorities for managing sites.

- Shell Chemical Crop Protection Portfolio – 240 sites in 70 countries
- Shell Oil – divested petrochemical facilities in Europe
- Chevron Oil – 5 refineries in the US
- Eli Lilly – 5 manufacturing and Superfund sites in the US, 1 in Brasil
- Shell Oil – multiple terminals and refineries in the eastern US
- Commonwealth Oil Company – Multiple facilities in Ponce, Puerto Rico
- Olin Corporation – 25 sites in the US.
- Bayer Crop Protection – 25 sites in Brasil, US, Europe and Far East.

REPRESENTATIVE SOLID WASTE DISPOSAL DESIGN

The following projects are representative of Mr. Hall's experience as a design engineer and engineer of record responsible for the conceptualization through final design of solid waste facilities.

Allied Chemical Corporation – Hydrologic studies through final design of a sludge disposal site for clay processing tailings at a plant in Atlanta, Georgia.

Kaiser Aluminum – Hydrologic studies through final design of a solid waste disposal site including fly ash at the Kaiser Aluminum Corp, Ravenswood, West Virginia.

Lynchburg Foundry – Conceptual through final design of fly ash landfill in Lynchburg, Virginia.

Engelhard Mineral Chemical – Design of slurry handling and sludge and tailings disposal facilities.

DuPont – Conceptual through final design of two boiler fly ash landfills at the Savannah River Plant, Aiken, South Carolina.

Buckeye-Cellulose – Conceptual through final design of the Oglethorpe landfill which receives fly ash, lime mud, sludge and cellulose wastes.

Macon-Kraft – Developed concept for hydraulic barrier in lieu of liners for an industrial landfill. Project doubled capacity and reduced total cost over a lined landfill.

REPRESENTATIVE HYDROLOGIC/HYDRAULIC DESIGN

The following projects are representative of Mr. Hall's experience as a design engineer and engineer of record responsible for the conceptualization through final design of water resource management facilities, both water supply and waste water management.

Sarasota, Florida, coordinated Water Supply Management Plan – Project Director and principal engineer for the conceptual through final design of a coordinated groundwater/surface supply system for the County of Sarasota, Florida.

Coal Bed Methane, Black Warrior Basin, Alabama – Principal engineer for the design of production water management systems to allow the discharge and assimilation of production water from methane production from approximately 5000 production wells throughout the Black Warrior Basin of Alabama.

Savannah River Harbor enlargement – Project Director for the Southern Environmental Law Center for the review of comprehensive environmental impacts across media for the deepening of the Savannah River.

Alabama Power Water Supply – Provided the assessment of water supply capacity from the Black Warrior River for power production in southern Alabama

Akzona, Enka, NC – Analysis of hydrologic/hydraulic parameters which produced severe flooding damage at an Akzona manufacturing plant in Enka, NC. Study required forensic hydrologic analysis to recreate the events leading to collapse of a railroad embankment.

DeKalb County, Georgia – Development of area-wide comprehensive water management plans for DeKalb County.

Bell Helicopter, Isfahan, Iran – Development of water management plan and river diversion design for a planned community for Bell Helicopter in Isfahan, Iran.

St. Lucia, West Indies – Determination of sedimentation rates and deposition patterns in the Cul-de-Sac River of St. Lucia, West Indies.

Oil Service Co., Iran – Assessment of flood protection measures for Marun-Ahway NGL Central Plan and Compressor units for Oil Service Company of Iran.

Chevron U.S.A. – Conducted extensive field and office investigations of water budgets, surface runoff quality and quantity, and groundwater characteristics of wetland system in Pascagoula, Mississippi for Chevron U.S.A.

Corps of Engineers – Development of conceptual plans for installation of dikes, channel widening projects and flood retention for Buffalo District of the Corps of Engineers.

Seminole Electric Cooperative – Performed field and office computer analysis of water quality impacts associated with a proposed 800-MW coal-fired power plant on the St. Johns River in Florida.

Chevron, USA – Assessed the dispersion characteristics of effluent plumes in Bayou Cassotte, Pascagoula, Mississippi

Pennsylvania Power & Light – Assessed ambient water quality of the Susquehanna River for Pennsylvania Power & Light

Placid Oil Company – Performed a riverine morphology assessment for Placid Oil Company on the Tombigbee River

Wisconsin Power and Light – Chief Hydrologist for the assessment and conceptual design of site facilities in the site selection process for nuclear facilities across the upper Midwest.

Miscellaneous Pulp and Paper Mills – Assessed loading rates and potential environmental impacts of the wastewater discharge from proposed Kraft Mills on the Savannah River in Georgia, and on the Leaf, Yalobush, and Tallahatchee Rivers in Mississippi.

Westvaco Corporation – Performed a complete site audit in Covington, Virginia to identify waste streams and potential contaminants and identify management alternatives for prevention of contaminant release and monitoring.

DuPont – Prepared a Groundwater Protection Plan for DuPont in Memphis, Tennessee. Plan included monitoring recommendations for a 600 –acre chemical facility with six different process streams and approximately 50 different solid and liquid waste management units.

Remington Arms, Ilion, NY – Prepared a Groundwater Protection Plan and Monitoring Plan along with development of a conceptual model for identification of monitoring requirements in terms of location and constituents to be sampled.

PUBLICATIONS

Pollution Prevention Approaches and Technologies, 1995. Hall, W.L., Vajda, G. F., Krieger, G.R., Accident Prevention Manual, Chapter 10, National Safety Council.

Geostatistical Based Cost Control Approach for Hazardous Waste Characterization and Remediation, 1993. Hall, W.L., Wild, M.R., Rouhani, S., Air & Waste Management Association 86th Annual Conference, Denver, Colorado.

Dam Design Criteria, 1988 Georgia Mining Association.

A Hydrobiological Study of a Pine/Wetland Mosaic, 1981. Hall, W.L., Simpson, T., Eighth Annual Wetlands Conference Proceedings, Hillsborough Community College, Tampa, Florida.

A Hydrobiological Investigation of a Mosaic Ecosystem; 1982. Hall, W.L., Simpson, T., In Land and Water Issues Related to Energy Development. Proceedings of the Fourth Annual Meeting of the International Society of Petroleum Industry Biologists.

Risk Reduction for Owners/Operators of Underground Tanks, 1988. Hall, W.L., Hallman E., Southeastern Oil Marketers Association.

Saline Water Disposal from a Coalbed Methane Recovery Well Field, 1984. Hall, W. L., Proceedings, American Society of Civil Engineers Hydraulics Specialty Conference.

Water Balance in a Florida Gulf Coast Pine Flatwood/Wetlands Mosaic, 1986. Hall, W.L., 13th Annual Wetlands Conference.

Process Water/Stormwater Discharge Strategy Contributes to Responsible Environmental Management, Lehman, T., Hall, W.L., Environmental Waste Management, January 1991, pg. 48.

Coalbed Methane Production Water Management, 1991. Luckianow, B., Hall, W.L. Coalbed Methane Symposium.

Realtime Instream Conductivity Monitoring on the Black Warrior River. Golden, W., Hall, B.L., 1991: Coalbed Methane Symposium.

NPDES Permits for Industrial Facility Stormwater Discharges for 1991 Georgia Water Resources Conference, Hall, W.L.

The Evaluation and Implementation of a Comprehensive Production Water Management Plan. W.C. Burkett, R. McDaniel, Taurus Exploration, Inc.; and W.L. Hall, Dames & Moore, Inc. for Coalbed Methane Symposium, 1991.

Economics of Production Water Storage. B.J. Luckianow, Taurus Exploration, Inc.; and W.L. Hall, Dames & Moore, Inc. for the Coalbed Methane Symposium, 1991.

Diffuser Design and River Modeling. P. Christiano and W.L. Hall, Dames & Moore for Coalbed Methane Symposium, 1991.

Water Storage Key Factor in Coalbed Methane Production, 1991. Hall, W.L.; Luckianow, B.; Oil & Gas Journal, March 1991. Pg. 79.

Case Studies of the Relative Effectiveness of Vegetative Systems for Remediation of Persistent Organic Pollutants, 2004. Proceedings for Seminario Internacional sobre Remediacao In-Situ de Sites Contaminados. Hall, W.L. and Odle, W.S.

Sustainable Land Development and Restoration: Decision Consequence Analysis, 2010, Elsevier Press, Brown, K., Hall, W. L, Snook, M., Garvin, K.

EXPERT TESTIMONY

Dennis Taylor, et al. v. Michelin North America, Inc. et al., US District Court for the Northern District of Oklahoma, Case No. 4:14-cv-00293.

KFC Corporation v. Iron Horse of Metairie Road, LLC and Iron Rooster, LLC, Eastern District of Louisiana, Case No. 2:16-cv-16791.

Aretha Abernathy, et al., Plaintiffs, CASE NO. CV 11-900266 Consolidated v. Occidental Chemical Corp., et al. in the Circuit Court of Colbert County, Alabama

Olin v. Insurance Company of North America et al., 84-cv-1968 (JSR) (SDNY)

Harold Cushman et al., v AVX Corporation in the Court of Common Pleas, Fifteenth Judicial Circuit, State of South Carolina

Kay County v. Freeport-McMoRan Copper & Gold Inc. in the District Court of Kay County, State of Oklahoma

13.0. Billing Rate and Signature Page

13.1 Billing Rate

Fees for my services including review of documentation and production of expert reports and declarations are billed by NewFields Companies, LLC at an hourly rate of $225.00. Time spent in deposition and trial is billed by NewFields Companies, LLC at an hourly rate of $350.00. The collection of fees and services provided by myself or NewFields Companies, LLC in this matter is not dependent on any particular outcome.

13.2 Signature

This report represents my best professional judgement based on my experience and the available information reviewed.

William L. Hall

July 5, 2019

Date

Appendix A – Lead-based Paint Analysis and Supporting Figures

A.1 Lead-Based Paint Analysis Supporting Information

This section provides additional supporting information for the tables of lead estimated from LBP provided in Sections 7.1.1.2 and 7.1.1.3.

The difference in specific gravity of LBP is demonstrated with the data provided by Sabin. Tables A-1 and A-2 provide a back calculation of the likely specific gravity and quantity of individual compounds for red lead based on the mixture quantities of lead pigment and carrier identified by Sabin. Tables A-3 and A-4 provide the same information for white lead. Tables A-5 and A-6 provide the same calculation for the maximum weight of LBP pigment of 26 pounds reported by Sabin, with a carrier weight equivalent to 5.5 pounds

As an example, Sabin identified that 33 pounds of red lead (pigment) and 1 gallon of oil would produce a mixture in which one gallon of paint had 22.57 pounds of lead pigment and 5.3 pounds of oil or carrier, for a total weight of almost 28 pounds for one gallon of paint (see Tables A-1 and A-2). Using an average specific gravity of 0.93 for the carrier oils, the specific gravity of the pigment would be 9.2. These values calibrate well with the chemistry of the pigment, as red lead, which is oxidized litharge, is slightly less dense then lead itself which has a specific gravity of slightly greater than 11.

As shown in Tables A-1 through A-6, Sabin input values provide lead content for LBP at the time of his analysis from a low estimate of 13 pounds per gallon to over 25 pounds per gallon.

Table A-1. Estimation of Contents of LBP- Red Lead

Constituent	Mixture Inputs		Mixture Results per Gallon		Backcalculated SP		Reference
	Value	Units	Value/Gallon	Units	SP	% of One Gallon by Volume	Red Lead and How to Use it in Paint. Alvah Horton Sabin, 1919, page 29
Lead Pigments	33	pounds	22.57	pounds	9.17	29.5%	
Oil (Linseed)	1	gallon	5.3	pounds	0.9	70.5%	
Mixture			27.87	pounds		100%	

Table A-2. Estimate of Pounds of Lead in Red Lead Paint

Calculation of Lead Pounds per Gallon from Specific Gravity (Red Lead)	
Weight of Pigment (lbs.)	22.57
% Volume of One Gallon as Pigment	29.47%
Weight if All Lead (lbs.) SG-11.25	27.69
Weight if All Carbonate (lbs.)- SG-2.1	5.23
% Between Carbonate and Lead	
Lead	77.21%
Carbonate	22.79%
Lead and Carbonate Weight (lbs.)	
Lead	21.38
Carbonate	1.19

Table A-3. Estimation of Contents of LBP - White Lead

Constituent	Mixture Results per Gallon		Backcalculated SP		Reference
	Value/Gallon	Units	SP	% of One Gallon by Volume	White Lead – Its Use in Paint. Alvah Ahorton Sabin.
Lead Pigments	16	pounds	6.57	29.17%	
Oil	5.5	pounds	0.93	70.8%	
Mixture	21.5	pounds		100%	

Table A-4. Estimate of Pounds of Lead in White Lead Paint

Calculation of Lead Pounds per Gallon from Specific Gravity (White Lead)	
Weight of Pigment (lbs.)	16
% Volume of One Gallon as Pigment	29.17%
Weight if All Lead (lbs.) SG-11.25	27.41
Weight if All Carbonate (lbs.) SG-2.1	5.18
% Between Carbonate and Lead	
Lead	48.69%
Carbonate	51.31%
Lead and Carbonate Weight (lbs.)	
Lead	13.34
Carbonate	2.66

Table A-5. Estimation of Contents of Heaviest LBP

Constituent	Mixture Results per Gallon		Backcalculated SP		Reference
	Value/Gallon	**Units**	**SP**	**% of One Gallon by Volume**	Maximum LBP Weights. Alvah Ahorton Sabin.
Lead Pigments	26	pounds	10.67	29.17%	
Oil	5.5	pounds	0.93	70.8%	
Mixture	31.5	pounds		100%	

Table A-6. Estimation of Pounds of Lead in Heaviest LBP

Calculation of Lead Pounds per Gallon from Specific Gravity (White Lead)	
Weight of Pigment (lbs.)	26
% Volume of One Gallon as Pigment	29.17%
Weight if All Lead (lbs.) SG-11.25	27.41
Weight if All Carbonate (lbs.) SG-2.1	5.18
% Between Carbonate and Lead	
Lead	93.68%
Carbonate	6.32%
Lead and Carbonate Weight (lbs.)	
Lead	25.67
Carbonate	0.33

The estimation of the range of the pounds of lead brought onto properties from LBP is probabilistic to account for independent variability among the variables relevant to the quantity of LBP used for buildings on a property. Two variables are precisely defined: date of home construction and current size of home as reported in the tax digest. The amount of LBP that could reasonably be expected to have been brought onto the property can be estimated as a range by utilizing a range for the input variables of square footage of painted surface, painting cycle, and lead content per gallon of paint by decade. For the purposes of this assessment, the estimate range is intended to demonstrate the relative mass of lead in soils versus the total mass of lead that could have reasonably been brought onto the property through LBP. Any lead brought onto the property through LBP either remains on the property on the walls of the buildings, in the property soils from paint deterioration, maintenance, and cleaning, on adjacent properties due to windblown dust or stormwater transport, or on some distant property through removal in construction or maintenance debris.

The range of the variables used in the probabilistic assessment of LBP brought onto properties is provided in Table A-7. Although red lead paint was likely used on properties, particularly for base coats and any metal surfaces, the range of lead used in the estimate is for white lead, as this type of LBP was commonly utilized for both interior and exterior uses. Further, although LBP continued to be used on interior surfaces after the 1950s, for this assessment it was assumed that no interior use occurred after 1950. Finally, although a resurgence of LBP use occurred in the late 1930s and 1940s, due to increased marketing by the industry, a steady decline in the lead content starting in 1930 was incorporated in this assessment.

The range of estimates of lead from LBP introduced to each of the four example properties is provided in Table A-8. The calculations were conducted using Oracle Crystal Ball Release 11.1.2.4.

Table A-7. Variable Distributions for Estimation of LBP inventory

Variable	Units	Maximum	Average	Minimum
Lead Pigment Pounds per Gallon up to 1930	pounds	17	16	15
Lead per Gallon	pounds	14.6	13.34	12.1
Carrier Specific Gravity	dimensionless	0.95	0.93	0.9
Carbonate Specific Gravity	dimensionless	3	2.1	1.5
Average Size of Rooms (all, including halls, bathrooms, and closets)	ft^2	144	100	64
Painting Cycle	years	12	10	8
Reduction in Lead Volume per Time Period				
Before 1930	% reduction of pre 1930 lead content range		0%	
1930 to 1950	% reduction of pre-1930 lead content range		25%	
1950 to 1965	% reduction of pre-1930 lead content range		67%	
1965 to 1978 (reduced lead content plus elimination of use on interior walls)	% reduction of pr3-1930 lead content range		95%	
After 1978 (no additional LBP application)	% reduction of pre-1930 lead content range		100%	

Table A-8. Estimates of Lead Brought onto Properties in LBP

PPIN	Minimum (ppm)	Lower One Standard Deviation (ppm)	Median (ppm)	Upper One Standard Deviation (ppm)	Maximum (ppm)
5271	982	1126	1275	1475	1790
5368	415	483	563	699	824
6643	223	254	271	287	326
7350	1783	1990	2125	2257	2498

A.2 Supporting Figures

This appendix section contains the supporting figures referenced in Section 7.0, a summary of which is provided below.

Figures A-1 – A-12: Plan Views of Transect Data

These figures show the sample locations and lead concentrations relative to the midpoint of the background range for all of the USMR and plaintiff transect properties. Individual properties are labeled with their PPINs. The inset box on each figure shows where the properties are located along each transect.

Figures A-13 – A-15: Individual property figures

These figures show the sample locations and lead concentration for exception properties discussed in Section 7.1.1.7.

Figure A-1: Maximum Lead Concentrations at Sampled Parcels Transect 1 Section 1

Figure A-2: Maximum Lead Concentrations at Sampled Parcels Transect 1 Section 2

Figure A-3: Maximum Lead Concentrations at Sampled Parcels Transect 1 Section 3

Figure A-4: Maximum Lead Concentrations at Sampled Parcels Transect 1 Section 4

Figure A-5: Maximum Lead Concentrations at Sampled Parcels Transect 2 Section 1

Figure A-6: Maximum Lead Concentrations at Sampled Parcels Transect 2 Section 2

Figure A-7: Maximum Lead Concentrations at Sampled Parcels Transect 2 Section 3

Figure A-8: Maximum Lead Concentrations at Sampled Parcels Transect 2 Section 4

Figure A-9: Maximum Lead Concentrations at Sampled Parcels Transect 3 Section 1

Figure A-10: Maximum Lead Concentrations at Sampled Parcels Transect 3 Section 2

Figure A-11: Maximum Lead Concentrations at Sampled Parcels Transect 3 Section 3

Figure A-12: Maximum Lead Concentrations at Sampled Parcels Transect 3 Section 4

Figure A-13: PPIN 10021 Average Lead Concentrations

Figure A-14: PPIN 10007 Average Lead Concentrations

Figure A-15: PPIN 7337 Average Lead Concentrations